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The development of the railway mail service during the last nine fiscal years is discussed in the last report of Postmaster-General Bissell. The statement may be tabulated as follows:

Year ending June 30.	Pieces distributed.	Errors in distribution.	Ratio 1 in.
1885	4,948,059,400	887,704	5,575
1886	5,329,521,475	1,260,443	4,228
1887	5,834,600,875	1,734,617	3,364
1888	6,528,772,060	1,765,821	3,698
1889	7,026,837,130	1,477,295	2,834
1891	8,546,370,090	2,005,975	4,261
1892	9,227,816,090	1,658,457	5,564
1893	9,772,075,820	1,347,880	7,144

The ratios here given show the number of pieces distributed correctly for each error made, and the record for 1893 is the best ever made in the service.

Improvements to the Toronto water supply in the form of an intake tunnel beneath the bay and a pipe conduit across Toronto Island and into Lake Ontario have been recommended by Mr. E. H. Keating, City Engineer. This would give water from practically the same source as now, but would do away with the present troublesome intake pipe. The tunnel would be brick lined 6½ ft. in diameter, 5,500 ft. in length, and its estimated cost is $250,000. There would be necessary 900 ft. of 5-ft. and 2,400 ft. of 6-ft. steel pipe, aside from the 7,000 ft. of 6-ft. steel pipe across the island and into the lake. The total estimated cost of the tunnel, pipes and accessories is $525,000. In addition, 16,000 ft. of 36-in. force main and other pipe within the city at an estimated cost of $185,000 is recommended. In his report Mr. Keating discusses and disapproves of the other various new water supply schemes that have been broached within the last two or three years.

Bids for the construction of about 20 miles of the Yaqui Canal, on the south side of the Yaqui River, in Sonora, Mexico, will be received until Dec. 20 by the Sonora & Sinaloa Irrigation Co., as stated in our advertising columns. The total length of the canal will be 30 miles, and it will cover 400,000 acres. It is said that this will be the largest amount of land for its length covered by any irrigating canal on this continent. The construction of the headworks of the canal has been in progress for some time. Col. E. S. Nettleton, formerly State Engineer of Colorado, is Chief Engineer of the company, and Mr. W. W. Follett, of Denver, has just gone to Mexico to join the company's engineering staff.

The commissioners of the District of Columbia wish to carry out the sewage disposal system recommended some two or three years ago by Messrs. Rudolph Hering, Samuel M. Gray and Frederick P. Stearns. To this end a bill has been drawn for presentation in Congress authorizing the issuance of $5,125,000 of bonds for trunk and outfall sewers.

The California Midwinter International Exposition, which opens on Jan. 1, 1894, has four of its five main buildings actively under construction. The largest building, devoted to manufactures, will be 450 × 200 ft., and is to cost $106,000. The mechanical art building, the next in size, is to be 275 × 175 ft., and is to cost $68,000. The fine arts building, the only brick structure, will be 120 ft. long by 60 ft. wide, and 40 ft. high; the contract price is $69,000. The agricultural building is 400 ft. long by 200 ft. wide, and is to cost $70,000 complete. The administration building has not yet been commenced. With the exception noted these buildings will be constructed of wood, plaster and cement, and the "staff" used so successfully at Chicago. Iron is only used in girders and roof trusses.

Underground conduits for electric wires in Washington, D. C., have reached an extent of 59.4 miles, according to the recent report of Capt. G. J. Fieberger, assistant to the Engineer Commissioner of the District of Columbia. The increase during the past five years has been 39.33 miles. Over half of the mileage in operation is owned by the United States Electric Lighting Co.; but the Western Union and Postal Telegraph companies and the local telephone company have each a considerable mileage. Captain Fieberger says:

From the difficulties encountered in locating these conduits in the streets it is evident that, in accommodating all the various telegraph wires, a single system of conduits must be used.

In 1891 a board of electrical experts recommended that a system of conduits with a total length of 318 miles be constructed for the cities of Washington and Georgetown, at an estimated cost of $490,000. These conduits would accommodate the overhead wires now in use and provide for all probable extensions of the various electrical systems. Captain Fieberger urges that the construction of this entire system of conduits be undertaken at once, as the construction of vaults and granolithic sidewalks in the business section of the city will increase the cost of laying these conduits from year to year.

A Chicago museum, magnificently endowed, is likely to be one outcome of the World's Fair, and the Palace of Fine Arts, in Jackson Park, is to be preserved for this purpose. Mr. Marshall Field has donated $1,000,000 toward the museum on condition that another million is raised outside, and Mr. George M. Pullman has given $100,000 on condition that $400,000 more is subscribed. The trustees for this musum are acuvely at work trying to raise the further amounts. The fine arts building selected is entirely fireproof, and is 500 ft. long by 320 ft. wide, intercepted by a transept and nave 100 ft. wide and 70 ft. high.

The most serious railway accident of the week was a head collision, Nov. 5, near Salvia, Nev., on the Central Pacific R. R., and was an addition to this summer's long list of accidents, caused by misunderstanding of orders. Both engines and 14 cars were wrecked. Six men were killed.—Train wreckers opened a switch and removed a switch lamp at a lime kiln side track near Ulin, Ill., on the Illinois Central R. R., and the New Orleans limited was partly wrecked. The engine, tender and baggage car were overturned and three men were killed. The passenger cars remained on the track and the wreckers did not venture to rob the train.

A locomotive boiler explosion occurred on the Iron Mountain R. R. at St. Louis, Mo., Nov. 2, and three men were killed. The engine was standing on the track at the time.

An electric car at Portland, Ore., ran into an open draw at the Madison St. bridge Nov. 1, and fell into the Willamette River. There was a heavy fog at the time, and the motorman could not see the danger light or the gates, and claims that the track was so slippery with frost that he could not stop the car. The car was crowded and seven persons were drowned. The coroner's jury charged the motorman with gross carelessness.

A bridge of somewhat novel design has been erected in Paris to carry the Rue de Tolbiac past the station of the Paris & Orleans Ry. It has three spans, aggregating 521½ ft. in length. The center piers are 197 ft. 9 ins. apart, c. to c., but the center span has an arched top chord and is continuous over the two piers, terminating at each end in cantilevers projecting 39½ ft. beyond the centers of the piers. The lower chord of this central span is horizontal between pier centers, but is inclined upward from the pier center to the ends of the cantilevers. At the ends of these cantilevers are suspended the two arched side spans of 128 ft. 9 ins. each, the outer ends resting upon rollers on the abutment piers, and the bottom chords of the end panels are also inclined upward. The bridge is 52½ ft. wide between centers of main girders, and is of riveted steel construction. The floor beams, of 52½ ft. span, are really heavy plate girders placed 19 ft. 8 ins. apart and curved on the top to conform with the roadway surface. The longitudinal stringers are 16-in. I-beams rolled especially for this bridge. The last panel member in the bottom chord of each truss is inclined upward, as before mentioned, in such manner that the point of suspension, for the cantilevers, and the abutment roller plates, are 7 ft. 8 ins. above the axis of the bottom chord proper. This disposition gives a large margin of stability and nearly nullifies wind action. The steel hinging pins are 2 ft. long. The total weight of the bridge is 1,163 tons, made up of 1,112 tons of rolled steel; 35 tons of cast and forged steel and 16 tons of cast iron. The estimated cost is $155,000.

A dry dock is proposed at New Orleans, and a Commission appointed by the Secretary of the Navy to survey its site is now at work.

The "Detroit," "Montgomery" and "Marblehead," three of the newest United States cruisers, have been found to be dangerously top-heavy, according to press reports. It is said that the fault is due to the placing of armament on the vessels considerably heavier than that for which they were designed, without the knowledge of the naval constructors who had the design of the hulls in charge.

The Russian Government has decided to build four important branches from the Transcaucasus Railway (from Poti to Baku, Engineering News, Feb. 11, 1888). One of 5 ft. 6 ins. gage, south to Borjam, 20 miles, and eventually to Kars; one meter gage north from Tiflis to Telar, 35 miles; another meter gage line from Ewiak to Khar Khendy, with 50 miles in the plain and 20 miles in the mountains; and a fourth from Navaji to Chamakn, 55 miles. Considerable local traffic is expected.

Electric lighting for railway cars has proved so successful on the London, Brighton & South Coast Railway, of England, that the company has given instructions for the equipment of ten more trains, making 40 complete trains lighted by electricity.

The contract for the Simplon tunnel was noted in our issue of Oct. 19, and a syndicate for carrying out the work has been organized by the Jura & Simplon Ry. Co. (with whose line the tunnel will connect), and the firms of Brandt, Branau & Co., of Hamburg; Locher & Co., of Zurich; Sulzer Bros., of Winterthur, and the Bank of Winterthur. A single track tunnel is to be in operation in 5½ years, and is to be widened for double track within four years after the opening of the line. The Jura & Simplon Ry. Co. will pay for the plant on the north and south ends, and this plant will be the property of that company after the road is completed. The cost of the tunnel and north approach is estimated as follows, it being expected that Italy will build the south approach:

Plant	$1,400,000
Single track tunnel and gallery for heading of second tunnel	9,500,000
Total for single track	10,900,000
Completion of double track tunnel	3,000,000
Total for double track	13,900,000
Northern approach	1,100,000
Total	$15,000,000

The record of passenger movement to Chicago during the 184 days of the Columbian Exposition, as compiled by the Chicago "Tribune," shows totals as follows, the figures representing in each case the total number of passengers, exclusive of commutation and sububan travel, arriving at Chicago over the road named during the six months period:

Chicago, Burlington & Quincy	2,300,000
Chicago & Alton	270,000
Chicago & Northwestern	4,500,000
Chicago, Milwaukee & St. Paul	637,000
Michigan Central	350,000
Chicago & Grand Trunk	367,903
Atchison, Topeka & Santa Fe	63,618
Baltimore & Ohio	581,500
Illinois Central	948,060
Pennsylvania lines	700,000
Wisconsin Central	53,174
Chicago & Erie	295,000
Chicago, Rock Island & Pacific	446,296
Wabash	200,000
Chicago & Great Western	100,000
Louisville, New Albany & Chicago	100,000
Lake Shore & Michigan Southern	630,000
Cleveland, Cincinnati, Chicago & St. Louis	94,000
Nickel Plate	127,000
Chicago & Eastern Illinois	60,000
Total	12,869,551

Many of these figures are apparently mere rough estimates, and we give them merely for what they are worth. According to the same authority, the Illinois Central Co. carried 18,178,803 passengers on its suburban and World's Fair trains, the Chicago City Ry. carried about 94,000,000 passengers, the West Side cable lines carried some 60,000,000 passengers, the North Side lines about 36,000,000, and 22,248,779 passengers rode on the Alley elevated.

ROADS AND STREETS AT THE WORLD'S COLUMBIAN EXPOSITION.

Country Roads.

The Columbian Exposition, at Chicago, is probably the first of its kind to include specimens of road construction among its exhibits, and it may be reasonably expected that the interesting and instructive exhibit made by the National League for Good Roads will have some influence in forwarding the movement for the very much needed improvement of our country highways. Considerable interest in the exhibit was shown by visitors, and many names were registered by persons of all classes and occupations. While some of these no doubt registered for the mere sake of writing their names, the majority (including not a few women) showed a practical and intelligent interest in the subject, as we noticed at different times when visiting the exhibit and the office where the register was kept. The League deserves much credit for the exhibit it made of specimen roads, and this exhibit was due largely to the energetic efforts of Gen. Roy Stone, the president of the league, who has since been appointed special agent and engineer to conduct investigations of road improvement under the Department of Agriculture. The work of construction of the exhibit was under the supervision of Mr. W. S. Bacot, M. Am. Soc. C. E., and the following is a pretty complete abstract of Mr. Bacot's report to General Stone:

The special object of the road exhibit adjoining the headquarters of the National League for Good Roads is to indicate correct methods of constructing country roads suitable for conditions and requirements commonly met with in actual practice. The exhibit is laid out and constructed in three strips running side by side, each strip representing a part of a highway of full width (from fence to fence). The widths selected are those which are usually adopted or required by existing highway laws, viz., two rods (33 ft.) two and a half rods (41¼ ft.) and three rods (50 ft.). Each strip is in turn divided into three sections about 20 ft. in length, thus making nine sections in all, each of which represents a class of road adapted to certain conditions and requirements.

The conditions which enter into and determine the manner of road construction are: 1, the grade of the road; 2, the nature of the soil; 3, the volume and nature of the traffic. Thus the grade determines the crown and to some extent the depth of the roadbed. The soil determines the depth and class of roadbed and also questions of drainage. The traffic determines the width of the roadway and of the roadbed, the depth and class of roadbed and the quality of road materials for the service required.

There is a logical arrangement of the sections, the corresponding sections in each strip are roads of equal width, but differ as follows: Section 1 in each strip is for roads of steep grades on firm, dry soils and light traffic; section 2, for roads of minimum or flat grades on wet and yielding soils and for heavy traffic, with provisions in each for subdrainage; and Section 3 in each strip is for roads of moderate grades on firm, dry soil and moderate traffic.

The methods of construction provided for the 2½ and 3 rod roads are identical, but the crowns vary accordingly. Both the 2½ and 3 rod roads are laid out symmetrically in cross-section, the traveling roadbed constructed in the center, with gutters and sidewalks on either side. The 2-rod roads vary from the others in having no sidewalks, but have deep side ditches in place of them; the traveled roadway is laid on one side of the center so as to afford an earth track for travel in dry seasons. The object of building this special type of road is chiefly for the sake of economy, the stone roadbed being but 8 ft. in width, abjoining the earth side track 16 ft. wide, which is both cheaper to build and cheaper to maintain.

There are three classes of construction of the stone roadbeds answering the requirements of grade, soil and traffic noted above. They are: macadam roadbeds 6 ins. and 8 ins. thick, and telford roadbeds, 12 ins. thick. The details of the construction of these classes are practically exhibited,, and the end of each section is stepped off so as to expose the successive courses of the work. Thus, in the 8-in. macadam we find: 1, the earthbed or formation surface, as it is called, showing the manner in which the road is shaped previous to laying the stone; 2, the first or bottom course of 2-in. broken stone 4 ins. thick; 3, the second or top course of 1½-in. broken stone 4 ins. thick; 4, the road surface finished with about ½-in. in thickness of stone screenings. The 6-in. macadam is constructed and finished in a similar manner, the top and bottom courses being 3 ins. instead of 4 ins. thick, the size of stone in each course being the same, 1½ ins. The telford roads consist of a course 8 ins. in depth of large stone roughly shaped and of about the proportions of granite paving blocks. The broadest edge is laid to the ground, leaving wedge-shaped openings between, which are afterward chocked with spalls made in shaping the telford stones. After the operation of laying, the tops of the stones are broken off and the whole work is wedged into a compact mass with bars and hammers. The second course consists of 1½-in. stone, sufficient to fill the remaining spaces in the telford bottom course; the third course is of the same size stone 4 ins. in depth and finished as before.

In every case a roller is an essential adjunct. A steam roller of 10 tons is to be preferred for economy, rapidity and general efficiency. A 5-ton horse roller may be used when the other is not obtainable, but at greater expense. The earth bed is to be rolled as well as the successive courses of stone, using a sprinkling cart in the case of screenings, sand or gravel binders, but working it dry with clay binder.

Gutters and side paths are formed on either side of the traveled road in such manner as to conform to the general shape of the road. Such work is included in the general excavation.

Subdrains are provided in Section 2 in each strip, i. e., for flat grades and wet soils; ditches are dug 4 ft. below the grade of the road on either side and underneath the stone roadbed so as to drain both sides equally. The ditches are 1 ft. wide at bottom, with sides sloping 3 ins. per foot rise. Tile pipes are used, 4 ins. diameter, with the joints left open. The remainder of the ditch is filled in to the top with stone, coarse cinders, gravel or similar materials found handy and the roadbed is built directly over it. The subdrains are left open for inspection in the west and middle strips. Wide, open ditches are provided in the two-rod roads in place of the sidewalks, which are not needed. Their office is to take the surface water quickly from the surface and keep the earth roadbed perfectly dry. In flat, wet country extra depth is desirable in order to obtain a degree of subsoil drainage. The latter plan of subdrainage may also be applied to the other types of roads with good effect in lieu of tile drains in the roadbed. In flat and particularly wet localities it is best to raise the grade of the road above the adjoining land a foot or so, using the earth from the side ditches to make the filling. The depth and width of the ditches should, as far as possible, be made to answer the requirements of the fill.

Quantities and Cost per Mile for Different Roads.

	Sec. 1.	Sec. 2.	Sec. 3.
East Strip.—33 ft. roads:			
Broken stone, cu. yds.	940	780	1,250
Telford or field stone, cu. yd.	....	1,300	....
Binder, cu. yd.	156	156	210
Cost	$3,050	....	$3,750
" with telford bottom	....	$5,150	....
" " field stone bottom	....	4,225	....
" of subdrainage	....	1,585	....
Middle Strip.—50 ft. roads:			
Broken stone, cu. yd.	1,875	1,565	2,500
Telford " " "	....	2,610	....
Binder, cu. yd.	315	315	420
Cost, road	$6,100	$10,350	$7,500
" subdrainage	....	1,585	....
West Strip.—41¼ ft. roads:			
Broken stone, cu. yd.	1,410	1,175	1,875
Telford " " "	....	1,960	....
Binder, cu. yd.	235	235	315
Cost, road	$4,575	$7,750	$5,635
" subdrainage	....	1,585	....

In the following notes on the dimensions, quantities and cost per mile the term "steep or maximum grades" applies between the limits of 4 and 10%, "moderate" or "medium grades" between 1 and 4%, and "flat" or "minimum grades" between 0 and ½ of 1%. The item of cost includes all excavations, shaping of roadway and digging ditches and gutters. Width of roadway means the distance between gutters or the space allotted to vehicles. (We have tabulated the quantities and cost per mile.—Ed.)

East Strip.—Two-rod roads. Width: fence to fence, 33 ft.; roadway, 25 ft.; wheelway, 8 ft.; earth road, 16 ft.; side ditches, 3 ft. at top, 1 ft. or more at bottom; depth of side ditches, from 1 ft. to 4 ft., according to conditions of soil, etc. Section 1: 6-in. macadam, for steep grades, firm, dry soils and light traffic; crown of wheelway, 3½ ins.; slope of side track, ½ in. per ft. Section 2: 12-in. telford (or field stone) roadbed for flat grades, wet and yielding soils, and heavy traffic, with subdrainage; crown of wheelway, 3½ ins.; slope of side track, ½ in. per ft. Section 3: 8-in. macadam road for moderate grades, firm, dry soils and moderate traffic; crown of wheelway, 3 ins.; slope of side track, ½ in. per ft.

West Strip.—2½ rod roads. Width (full), 41¼ ft.; roadway, 25 ft.; wheelway, 12 ft.; sidewalks, 8⅛ ft. Section 1: 6-in. macadam for steep grades, firm, dry soils and light traffic; crown of wheelway, 5 ins.; depth of gutters below center grade, 12 ins.; slope of sidewalks (¼-in. per ft.) 4 ins. Section 2: 12-in. telford road for flat grades, wet and yielding soils and heavy traffic, with subdrainage; crown of wheelway, 5 ins.; depth of gutters below center grade, 12 ins.; fall of sidewalks, 4 ins. Section 3: 8-in. macadam road for moderate grades, firm, dry soils and moderate traffic; crown of wheelway, 4 ins.; depth of gutters below center grade, 10 ins.; fall of sidewalks, 4 ins.

Middle Strip.—Three-rod roads. Width (full), 50 ft.; roadway, 30 ft.; wheelway, 16 ft.; sidewalks, 10 ft. Section 1: 6-in. macadam for steep grades, firm, dry soils and light traffic; crown of wheelway, 6 ins.; depth of gutters below center grade, 16 ins.; fall of sidewalks, 5 ins. Section 2: 12-in. telford road for flat grades, wet or yielding soils and heavy traffic; crown of wheelway, 6 ins.; depth of gutters below center grade, 16 ins.; fall of sidewalks, 5 ins. Section 3: 8-in. macadam road for moderate grades, firm, dry soils and moderate traffic; crown of wheelway, 5 ins.; depth of gutters below center grade, 12 ins.; fall of sidewalks, 5 ins.

The tabulated estimates of quantities of broken stone required are based on an allowance of 20% additional, over and above the space to be filled, for compression of materials; and 20% for binders. Similarly for telford stone, an extra allowance of 25% is made. The cost is based on the following prices for completed work per square yard, including cost of excavation:

6-in. macadam per sq. yd.	$.65
8-in. macadam per sq. yd.	.80
12-in. telford per sq. yd.	1.10
12-in. field stone per sq. yd.	.90
Tile subdrain per lin. ft.	.30

The quality of stone used in the exhibit was not regarded of special importance except as to gradation of sizes, as the aim was simply to indicate methods of putting roadwork in place and to leave the question of hardness of stone, durability, efficiency, etc., to be locally determined. The limestone was furnished by Dolese & Shepard, of Chicago, and was a dolomite of excellent quality. It is extensively used on the streets and boulevards of that city, but it wears rapidly under heavy traffic. For telford purposes it was suitable as to hardness, but broke badly. The Rhinebeck iron ore is only adapted to country roads and makes a suitable surfacing. In point of hardness it is inferior. The Breakneck granite furnished by the Hudson River Supply Co. was superior to either of the others.

On steep grades, paved gutters would be required in some places. The amount required would vary very largely, and it has not for this reason been taken into account in the above estimates. The sidewalks have foot paths 4 ft. wide laid in the center of the walk, with turf borders on either side, leaving room for trees to be planted on the edge of the gutter. About 3 ins. of gravel is spread on the foot paths, which are slightly rounded.

In localities where rock is a scarce commodity, field stone, if obtainable along the route, may be substituted for the telford stone, with some economy. It is not a desirable expedient, unless reduction of cost is imperative. When field stone is so used, the course of broken stone superimposed should not be less than 4 ins. in thickness when solidified. The only estimate made on the cost of such work is in the case of the two-rod roads where cheapness of first cost is the chief consideration.

Roadways of the Exposition.

The roadways of the Exposition include telford and macadam roads and gravel walks. On the roads and open spaces constant light repairs were kept up, worn and hollow spots being covered with a few shovelfuls of screenings and rolled by small steam rollers. The material used was a very limy stone, which was painfully glaring when dry and made a sticky mud when wet. The following is an abstract of a recent report made by Mr. R. Ulrich, Superintendent of Landscape, Road and Miscellaneous Departments:

The time occupied on the road work lasted six months in 1892 and four months in 1893. The total area covered was 574,933 sq. yds., or equivalent to 49.4 miles of 20-ft. roads, or 119½ acres. The material used was 124,785 cu. yds., partly of Joliet gravel and partly of crushed lime rock, of various grades, and the contract price was $319,198. The roads, on the whole, have been fairly constructed, although by no means up to the desired requirements. As the contract called only for 4 ins. of hard rolled material, the roads being subjected to far heavier traffic than was supposed or intended by any one, at times, it has been found entirely impossible to do really first-class work, owing to the impracticability of suspending traffic while the roads were in process of construction, as it was necessary to keep them constantly open and in use on account of the urgency with which all work on the Exposition grounds was being pushed to completion. Especially was the work damaged and retarded by the late removal of railway tracks and by reason of so much underground work being projected and started subsequent to the construction of the roads. This led to their being ruthlessly cut up in almost every possible direction, and these practices have been continued. The various departments have been the cause of a

great deal of extra labor, and, in many places, the unsatisfactory condition of the grades was due to the everlasting disturbances caused by the Westinghouse Electric & Mfg. Co., the Waukesha Hygeia Mineral Springs Co., the Hyde Park Gas Co. and the various construction and other departments of the Exposition. The digging of trenches by the Electrical Department by cutting two to three feet deep through the frozen ground was especially injurious to the roads, and its effects are felt to-day. The drainage, in many places, was also imperfect, and grates and catch basins had to be readjusted and replaced throughout the park.

The foundation of nearly all the walks and roads is very fortunately of sand, which is the very best that could be had to resist the effects of a severe winter and reduce heaving to a minimum. Experience has taught us that macadam or broken limestone is giving better satisfaction than the so-called Joliet gravel, and this year the gravel from Joliet was used for repairs only, the greater part of all roads and walks being built of lime rock. The weather being exceedingly favorable during the whole summer, the roads were kept in tolerably good and satisfactory condition, free from dust, mud and other nuisances.

In connection with the brick paving, all subgrading was done by the Exposition company in a careful and workmanlike manner, as well as the irregularities of the buildings would permit. In the lodges, courts, entrances and approaches of the most prominent buildings were 51,576 sq. yds. of brick pavement, costing $39,608.

The average force engaged in the construction of roads by the contractors, Kimball & Cobb Stone Co., from June 27 to Dec. 31, 1892, was 57.88 men, 19.84 teams and 5 rollers. During 1893 it has been 6½ foremen, 248½ men, 57¾ teams, 11½ carts and 15 sprinkling wagons.

Two samples of improved construction for country roads were shown by the Western Wheeled Scraper Co., of Aurora, Ill., in connection with its road machinery exhibit in the Agriculture Building. One of these was a telford road, with 6 ins. of coarse stone, 4 ins. of medium and 2 ins. of fine crushed stone. The cost for a 15-ft. roadway was given as $3,000 per mile where stone can be obtained at $1 per cu. yd. The other road was built of burnt clay, having 6 ins. of coarse and 4 ins. of medium size, and a top dressing of 2 ins. of fine crushed stone. Tile drains are laid below subgrade. The cost for a 15-ft. roadway was given at $2,000 per mile, with coal not exceeding $2 per ton. Burnt clay is a somewhat new material for road construction, but it is coming into increasing use for ballast on Western railways, and we shall publish shortly an article on the burning of clay for ballast.

Street Paving.

Both rock and Trinidad lake asphalt were represented in the Mining Building. The Compagnie Generale des Asphaltes de France (New York Mastic Works, New York) had specimens of the crude rock asphalt from the company's mines, at Seyssel, France, and elsewhere. There were also the prepared blocks ready to be melted down for paving material, and samples of street and sidewalk pavements of compressed asphalt on concrete. The Seyssel asphalt paving has been described in our issues of Sept. 28, 1889, and Jan. 25, 1890. The Warren-Scharf Asphalt Paving Co., of New York, had an extensive and handsomely displayed exhibit of its material and work, including specimens of the crude lake asphalt and the finished pavement, and a model of the plant for preparing the material for paving purposes. A sample piece of pavement was shown, cut from paving laid on Race St., Cincinnati, in July, 1886, and was in good condition when the piece was cut out in March, 1893, after a service of six years eight months. The asphalt is 2½ ins. thick on an 8-in. bed of concrete. The travel over this pavement was 204 tons per sq. ft. per day, or 495,720 tons in the time given above. The cost, with five years' guaranty, was $2.90 per sq. yd., and the cost of repairs during the second five years has been 46 cts. per sq. yd. This company also shows its arrangement for street railway tracks laid with T-rails in connection with asphalt paving, as described and illustrated in our issue of Feb. 23, 1893. A row of granite blocks is laid along each side of the rail, and the space over the rail flange is filled in with a grout of hydraulic concrete, covered with a special composition of Trinidad asphalt poured and tamped around the rail head. The Barber Asphalt Paving Co., of New York, also had an elaborately displayed exhibit, including samples of the lake asphalt, California bituminous rock, and a model of the Trinidad pitch lake. There is also a model of the plant for treating the material. Sample blocks are shown cut from asphalt pavements on concrete foundations in various cities, and also a sample (cut out at Thirty-third St.) of the pavement on Fifth Ave., New York, where the old stone block pavement was used as a foundation, a gravel and bituminous coating being laid to bring it to a smooth surface, and the asphalt proper then laid upon it (Eng. News, June 9, 1892). The Trinidad pitch lake and its asphalt were described in our issue of May 5, 1892, and the specifications for asphalt paving in New York were given in our issue of Nov. 16, 1889. The total amount of Trinidad asphalt pavement in the United States is given as follows:

	Sq. yds.	Miles.
Barber Asphalt Paving Co.	6,431,790	421.67
29 other contractors	5,481,917	359.40
Total in 64 cities	11,913,707	781.07

Blocks of pavement laid at Bellefontaine, O., of Buckeye cement and gravel, in service for two years under heavy traffic, are shown by the Buckeye Portland Cement Co., of Bellefontaine, O. Artificial stone, sidewalks, etc., made with Saylor's Portland cement, are shown by the Coplay Cement Co., of Allentown, Pa. In wood paving, New South Wales exhibits the paving blocks of black butt (eucalyptus) used in that colony, and photographs of paving work in progress at Sydney. The wood is very dense and heavy, and the blocks are $6 \times 2\frac{3}{4} \times 8\frac{1}{2}$ ins., laid on a concrete foundation. The Landis Steel Curbing Co., of Lancaster, Pa., exhibits the steel street curbing invented by I. L. Landis, consisting of flat bars or angle iron facing the edge of the sidewalk, and secured by tie-rods under the pavement. It has been applied to the heavy flagstone sidewalk in front of the Unity Building, on Dearborn St., Chicago, to protect the flagstones from injury by the wheels of wagons backed against the sidewalk. It may be made in various styles, and applied for edging cement walks, roadways, etc.

In a later issue we shall describe the exhibits of roadmaking machinery, rollers, sprinklers, stone crushers, etc.

THE TRANSVERSE STRENGTH OF CONCRETE.

In a paper recently read before the Institution of Civil Engineers, Mr. A. F. Bruce describes the results of a very interesting series of experiments made to determine the transverse strength of concrete beams and the resistance to thrust of short span concrete arches. Owing to the almost total lack of information on these points, these experiments are especially interesting and we reprint the article nearly in full, omitting only the several tables which largely duplicate the information given in the diagrams:

Although many valuable papers have been written on the testing and strength of Portland cement, little attention appears to have been paid to the testing of concrete, the only systematic series of tests given in recent volumes of the "Proceedings" being contained in Mr. Darnton Hutton's remarks in the discussion upon "Portland Cement and Portland Cement Concrete" (Vol. LXII.) and Mr. J. Kyle's paper on "Colombo Harbour Works, Ceylon" (Vol. LXXXVII.). It has, therefore, occurred to the author that the results of a number of experiments made by him, while resident engineer on the Blane Valley section of the Glasgow Corporation Water-Works, might not be without interest.

The object of these experiments was to ascertain the growth of the transverse strength or modulus of rupture of bars of concrete, and of the resistance to thrust in arch-ribs of different concrete mixtures. It was desired also to establish, if possible, a ratio between these two forms of strain, so that the probable strength to oppose the one might, with a fair approximation to accuracy, be estimated from the tests obtained with the other. As concrete is in practice usually subjected to a maximum stress within three or four months after being placed in position, attention has been chiefly directed to its strength at early ages—few bars having been kept beyond six months, while none of the arch-ribs were older than 12 months; the difficulty of applying sufficient weight to destroy the latter, as the strength increased, had also to be considered.

A considerable variety of materials were experimented with, namely, hard and soft sandstone, whinstone gravel, sand from sand pits, river sand, and sand prepared by crushing sandstone and whinstone. The proportions used varied from 5 to 1 to 12 to 1, none being adopted which did not completely fill (1) the voids in the sand with cement, and (2) those in the stones with mortar. These voids amount in the sand to from 33% to 34%; in gravel, to 34%; in broken sandstone, 40 to 42%; and in whinstone to from 46 to 50%. Gravel is, therefore, all other things being equal, the most, and whinstone the least, economical material to use.

Test-bars were made in molds 30 ins. long and 4 ins. square, the bottoms being loose, and the sides tenoned through the ends and secured with iron pins. The blocks were usually left in the molds for about five days; they were then placed in tubs under water till the day before that fixed for testing them, when they were taken out of the water and weighed. After being allowed to dry, they were again weighed, the difference in weight being taken to be a measure of the porosity of the bar. Bars were at first molded in sets of three at a time, and they were all broken at the same date. Afterward the number was increased to six or more,

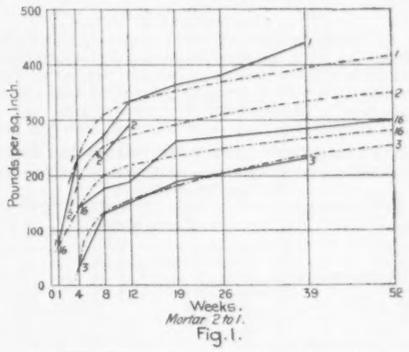


Fig. 1.

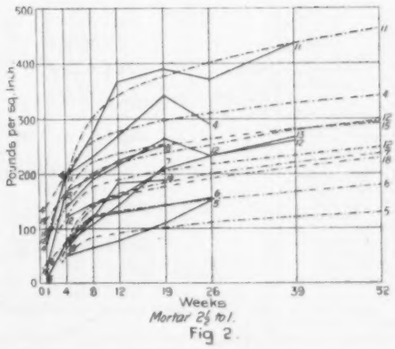


Fig 2.

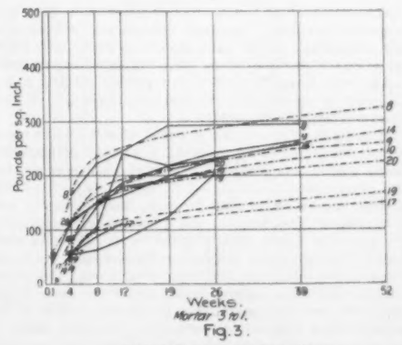


Fig. 3.

Calculated Curves shown thus - - - - -
Results of Observations shown thus ———

Diagrams Showing Growth in Strength of Concrete Beams.

and only one or at most two were broken on the same day; the gradual growth of strength in a series could thus be observed. The total number of tests was about three hundred. Figs. 1, 2 and 3 show the results of these observations contrasted with the values obtained by calculation, according to the method described hereafter, in certain cases. The testing machine employed was that known as Adie's small machine; the briquette-clips being removed, a suspension-bar, formed of iron, 1½ in. by ⅝ in., was attached to the end of the lever, having the tension screw secured to its lower extremity; this was provided with a stirrup passing beneath the test-bar. The latter was held down by iron clamps at either end, 27 ins. apart in the clear, screwed down to the floor joists. When placed in position, the test-bars were broken in the usual way by moving the vernier weight along the lever.

The modulus of rupture has been calculated by inverting the familiar formula for the strength of beams,

$$f = \frac{3\,W\,L}{2\,b\,h^2} = \frac{3\,W \times 27}{2 \times 4^2} = 0.633\,W,$$

where W is the breaking weight indicated by the machine less the weight of the bar and that of the extra ironwork; this amounted usually to about 60 lbs.

The author has endeavored to arrive at a formula by which the growth of strength in concrete may be calculated; a slightly modified form of the equation suggested by Prof. W. C. Unwin, M. Inst. C. E., for Portland cement * would appear to be the most suitable, and has been used for the calculations.

If x = age of bar in weeks.

f = modulus of rupture at x weeks.

a = modulus of rupture at 4 weeks.

b = constant for increase of strength.

$b = \frac{f - a}{\sqrt[3]{x - 4}}$, a mean of observations being taken.

Then

$$f = a + b\sqrt[3]{x - 4}.$$

Of course, in order to obtain a thoroughly reliable value for b, a considerable number of observations would be necessary, as an accidentally low test at four weeks would tend to give it an abnormally high value; otherwise it depends chiefly on the mortar used.

In several cases bars were placed in water in the molds within four hours after mixture, and were subsequently broken at the same date as others treated in the usual way. These tests showed in every case a loss of strength of from 16 to 25%; the same experiments made with briquettes showed a similar result. A bar allowed to set in the air was only about 5% weaker than one kept under water.

Table I.—Showing Resistance of Arches to Fracture in Lbs per Square Inch.

Parts to 1 of cement.	Composition.	Age in Weeks. 1		2		4		8		12	
		S	S/f	S	S/f	S	S/f	S	S/f	S	S/f
3	Sandstone crushed			552	2.0*						
2											
5	Sandstone crushed							908	4.5		
2½											
7	Sandstone crushed	190	5.2			426	3.0*	925	5.4		
3											
3	Whinstone crushed	405	2.0*			1,846	4.3				
1	Sandstone..										
6	Whinstone										
2½	Pit sand...					435	6.1			1,160	6.8
5	Whinstone crushed										
1											
2	Sandstone..			7				912	8.7	1,058	6.0
3	Gravel.....										
2	Crushed sandstone			834	3.8	2,022	6.7				
5	Gravel.....										
3	Pit sand...					663	5.8				
7	Gravel.....									990	6.1
3	Pit sand bad quality			245	5.8	421	6.7				

* Appeared to yield prematurely owing to insufficient loading on one haunch.

In order to ascertain the strength of concrete to resist thrust in the form of an arch, a number of arch-ribs were made. At first the centering employed in the aqueduct tunnels, having 10 ft. span and 5 ft. 8 ins. radius, was used for this purpose; but latterly it was found more convenient to use a smaller centering of 3 ft. span, the radius remaining the same. The ribs were made 2 ins. square at the crown, increasing in thickness toward the haunches, the top being level. The abutments were substantially built, and were made to do duty over and over again, only the center portion of the arches being renewed for each test. Care was taken to keep them moist while they were setting, by throwing wet bags over them. The arches were broken by building up lead bars weighing 1 cwt. (112 lbs.) each, on a small platform, distributing the weight equally over 18 ins. to 24 ins. of the crown, as the case might be, ordinary weights being used to graduate the load. The haunches were simultaneously loaded to balance the weight on the crown, though in one or two instances the weight used was not sufficient.

The thrust per square inch was calculated in the usual way, as equal to the breaking weight per foot run multiplied into the radius, and divided by the area of the section, or

$$S = \frac{W\,R}{A}.$$

Unfortunately, as already mentioned, it was impossible to carry out these tests at considerable ages, nor could they well be multiplied to the same extent as those for transverse strength; but as they appear to fluctuate less than the latter tests, the results obtained may be considered fairly satisfactory as far as they go. They are given in Table I.

Comparing the tests for transverse strength with those of resistance to thrust, the ratio of $\frac{S}{f}$ would appear to show a tendency to gradual increase with age, or, in other words, the power to resist crushing-stress grows faster than the transverse strength. Thus the mean ratio for one and two weeks old was 4 = 8; for four weeks, 5 = 9; for eight weeks, 6 = 1; and for 12 weeks' old, 6 = 2. From this it follows that where concrete is to be subjected to compressive stress, as is almost invariably the case, the modulus of rupture found experimentally may, with perfect safety, be adopted as the working load; especially as, in arches of practical dimensions, concrete is much more favorably placed for resisting stress than in small ribs.

* Minutes of Proceedings Inst. C. E., Vol. LXXXIV., p. 399.

COMPOUND EXPRESS LOCOMOTIVE; CHICAGO, MILWAUKEE & ST. PAUL RY.

(With inset.)

The engine of which we give drawings on our inset sheet this week is one of those exhibited at the World's Columbian Exposition by the Rhode Island Locomotive Works, of Providence, R. I., and is an interesting example of the tendency toward the use of engines with six driving wheels for heavy express trains, especially where frequent stops require a prompt raising of the train to high speed. The engine is one of three built for this class of service on the Chicago, Milwaukee & St. Paul Ry., intended mainly for running on the Chicago and Milwaukee division, 85 miles. They are peculiar in having a small pair of trailing wheels, which is for the purpose of keeping the wheel load within specified limits. The engine is a handsome and powerful machine, and its appearance is that of extreme simplicity. The boiler is of the extended wagon top pattern, and being of large diameter is placed high up in order to clear the very large (78-in.) driving wheels. A Canadian Pacific Ry. ten-wheel engine with 75-in. driving wheels, was illustrated and described in our issue of Aug. 30, 1890. The fuel will be bituminous coal. Balanced slide valves are used, and the valve rods are extended through the front end of the steam chests. The Jerome metallic packing is used on piston rods and valve stems. The tender has a wooden frame and is carried on two diamond frame trucks with side bearings to both trucks, and outside hung brakes with wooden brakebeams. The tank has inside sloping surfaces, with lockers having outside doors, the arrangement being similar to that of the Wabash R. R. tender, illustrated in our issue of Dec. 1, 1892. We gave a perspective view and full description of this engine in our issue of June 15, and from that description we abstract the following leading dimensions:

Driving wheels, diam.	6 ft. 6 ins.
Truck " " (leading)	2 ft. 9 ins.
" " " (trailing)	3 ft. 6 ins.
Wheel base, driving	13 ft. 6 ins.
" " engine	29 ft. 9¼ ins.
" " tender	15 ft. 0 ins.
" " engine and tender	50 ft. 6¾ ins.
Weight in working order, on drivers	88,500 lbs.
" on trucks (36,500 lbs., 15,000 lbs.)	51,500 lbs.
" total engine	143,000 lbs.
" engine and tender	218,000 lbs.
Cylinders (two)	21 x 26 ins. and 31 x 26 ins.
Connecting rod, length between centers	10 ft. 3½ ins.
Boiler, diam. inside	5 ft. 2 ins.
" barrel plates	⅝ in.
" tube plates	½ in.
" height from rail to c. line	8 ft. 11 ins.
Working pressure	200 lbs.
Firebox	10 ft. 0 ins. x 2 ft. 9¾ ins.
Grate area	28 sq. ft.
Tubes, 272; diam. outside, 2 ins.; inside, 1¾ ins.	
" length between tube plates	12 ft. 8⅝ ins.
Smokestack, length from rail to top	15 ft. 2 ins.
Capacity of tank	4,000 gallons
" coal space	13,440 lbs.

WIRE ROPEWAYS AT THE COLUMBIAN EXPOSITION.

The wire rope cableways or tramways at the Exposition represent a method of transportation which has been extensively used by European engineers during the past 20 years, but which has only within very recent years been adopted to any considerable extent in this country. The advantages of these wire ropeways or tramways, particularly for mining purposes and in mountainous country, were noted in our issue of April 7, 1888; and in that of Sept. 7, 1889, we described the line built at Geddes, N. Y., by the Trenton Iron Co., on the Bleichert system which had been already extensively applied in Germany. Since that time wire ropeways have steadily come into increasing use in this country. They are on two systems: 1, the single or running rope system, in which the buckets or carriers are attached to clips fixed to the rope, and must be loaded and unloaded while moving; 2, the double or standing rope system in which the buckets are suspended from carriers running on a fixed cable and are attached to a continuously running traction rope by grips, which can be gripped or released at will. Single rope systems at Pioneosas, Mexico, and San Juan, Lower California, have been described and illustrated in our issues of March 21, 1891, and Feb. 16, 1893. Double rope systems have been described in our issues of Jan. 1 and Oct. 29, 1887 (Germany); July 25, 1891 (Spain); and April 2 and 16, 1892 (United States).

The California Wire Works, of San Francisco, Cal., showed a specimen of the Hallidie single rope system, invented by Mr. A. S. Hallidie (originator of the street cable railway), in 1871. This was one of the first used in this country, and has been quite extensively applied. One of the Hallidie lines, at the mines at San Juan, in Lower California, was described in our issue of Feb. 16, 1893, and details were shown of the clip, the grip pulley or driving pulley, and other details. About 60 lines, aggregating 28 miles, have been built on this system in the United States, Mexico, Honduras and Hawaii. C. W. Badgley & Co., of Denver, Col., showed Huson's patent automatic wire rope tramway, which is also of the single rope system, and in which the loading and dumping of the buckets is effected automatically. The upper terminal is fitted with a loading hopper, a horizontal sprocket wheel whose teeth engage with the bail of the bucket and hold it ready during loading,

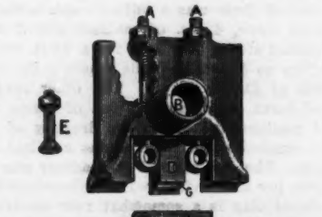
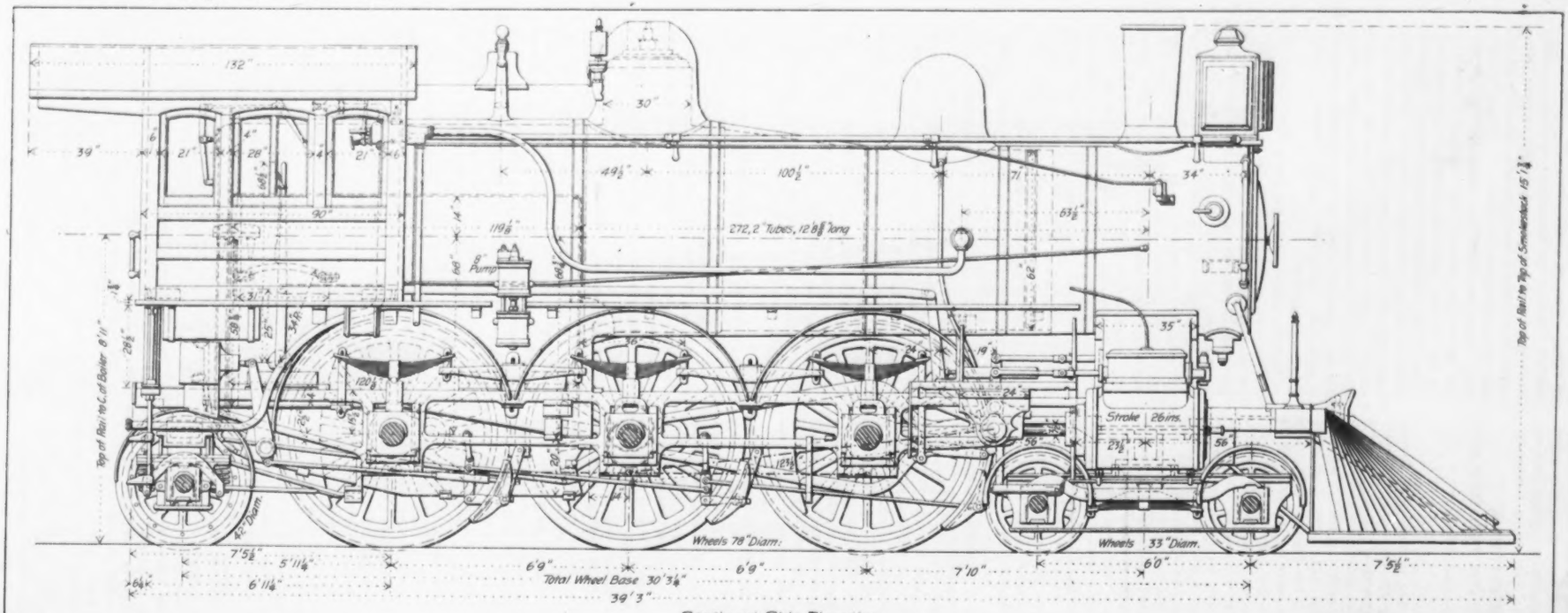
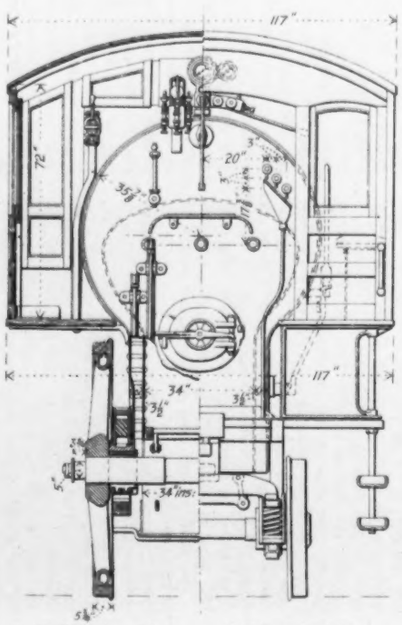


Fig. 1. Huson Fixed Clip for Single Rope Wire Tramway.

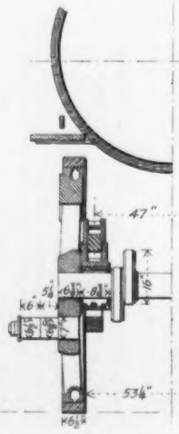
and a horizontal grip wheel for the cable. When the grade is very steep a band brake is fitted to a rim cast on the under side of the sprocket wheel, the sprocket and grip wheels being on the same vertical shaft. As a bucket reaches the terminal its pendant, or suspension rod, strikes a stop on the loading car. This car is of the same capacity as the bucket, and travels about one-third of the distance round the terminal, on an inclined rail, meanwhile discharging its contents into the bucket, and then returning to its receiving position. The lower terminal has a grip wheel, sprocket wheel and dumping bar. This lower terminal is generally inclined according to the grade of the line, and a traveling cage catches the pendant of the descending bucket and changes it from a vertical position to a position perpendicular to the rope, holding the pendant thus until the sprocket wheel engages with the bail of the bucket, when the cage is released and returned to its position by counterweights. In passing around the terminal the bucket is tilted over on its axis by an inclined bar fixed to the timber framing. The lower terminal is usually arranged to slide upon sills, allowing a movement of about 15 ft., so that the cableway may be tightened without cutting and splicing the rope. The intermediate sheaves which support the rope are carried upon trestle bents. Where the tramway passes several mines, automatic loaders can be placed at any desired point, each being attended only by one man, who can load alternate buckets or any desired number of buckets. The operation is similar to that of the terminal loading hopper. The horizontal grip wheel or driving pulley at each terminal has eight automatic jaw grips which hold the rope on the



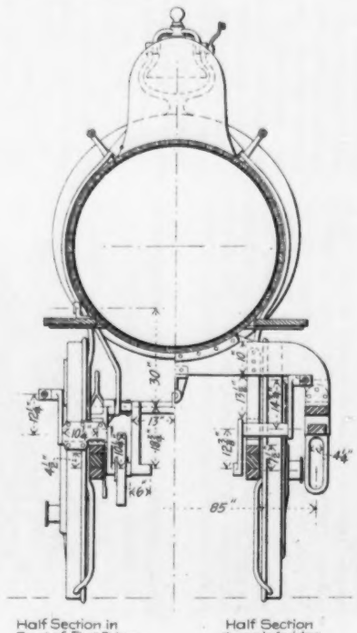
Sectional Side Elevation.



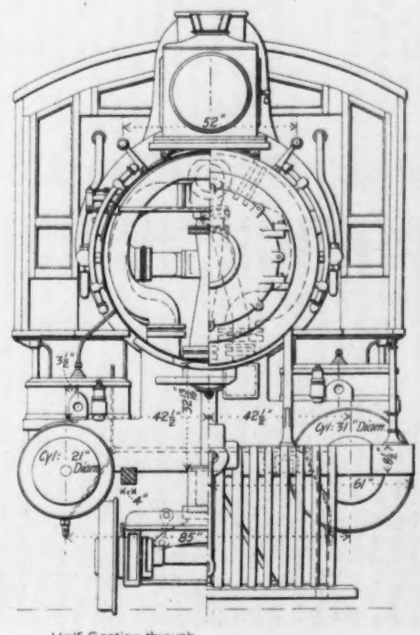
Half Section of Cab. Half Rear Elevation.



Half Section through Main Driver.



Half Section in Front of First Driver. Half Section through Guides.

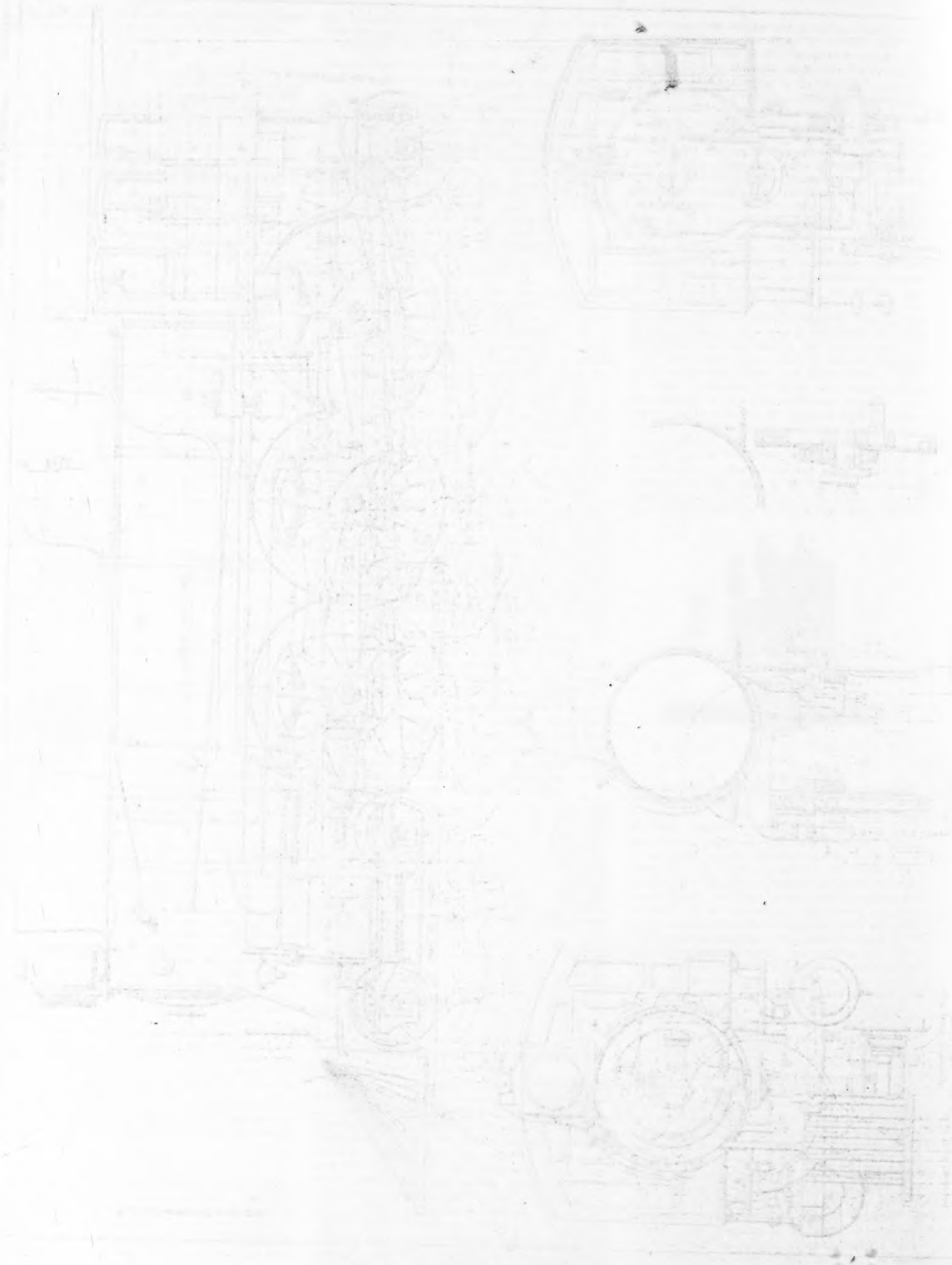


Half Section through Smoke Box. Half Front Elevation.

Two-Cylinder Compound Express Locomotive; Chicago, Milwaukee & St. Paul Ry.

Builders, Rhode Island Locomotive Works. Superintendent of Motive Power, J. N. Barr.

CHAS. HART & SONS, LITH., 31 VESEY ST., N. Y.



arriving side and release it on the departing side of the wheel. These jaws act independently of the size of rope or wear of wheel. The average ores dealt with weigh 150 lbs. per bucket. The company has now about 280,000 ft. of cable running on the Huson system, carrying mainly ore and limestone. Two of these, both in Colorado, are respectively 2,279 ft. and 5,790 ft. long, while a third, 2,250 ft. long, crosses two canyons by spans of 395 and 435 ft.

The form of clip used to attach the bucket to the rope is shown in the cut, Fig. 1 (where it is shown as ready to be bolted up), and it is claimed that it is entirely satisfactory on heavy grades and sharp curves, and will be torn from the rope before it will slip upon it. The upper part is lowered upon the rope and the bolts E then passed through the holes F of the lower band C and through the eyelets on the ends of the vertical bolts A, the nuts of which are then screwed up tight, forcing the grooved jaw G upon the rope, and the bolts E are then finally tightened up. The upper end of the bucket hanger or pendant is bent to fit into the hole B of the clip.

The Trenton Iron Co., of Trenton, N. J., had in operation in the Exposition grounds a line on the Bleichert system. This is a double rope system invented in Germany, which was introduced in this country by the Trenton Iron Co., being one of the first double rope systems used here, and one of the first lines built by the company (at Geddes, N. Y., for the Solvay Process Co.) was described in our issue of Sept. 7, 1889. The double rope system has a

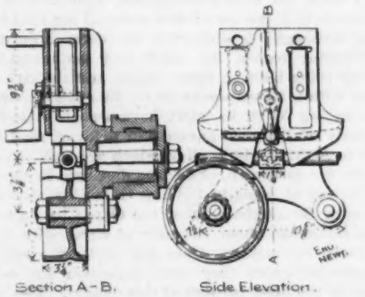


Fig 2. Bleichert Detachable Grip for Wire Tramway.

wider application and is more satisfactory in many ways than the single rope system. The buckets are hung by the bails from a two-wheeled carriage, with grooved wheels running on the upper rope, while the grip and the guide pulleys for the traction rope are attached to a frame underneath the carrier. The company uses two styles of grip, a friction grip for use on moderate grades, and a lug grip for use on steep inclines where the weight of the bucket or load has a tendency to cause the rope to slip through the friction grip. For the latter arrangement lugs or thimbles are attached to the traction rope, and engage with stops or jaws on the grip, as shown in Fig. 2. At terminals, switches or turnouts, the grips are automatically released, the latch handle shown in the cut being thrown up by an inclined rail, thus raising the jaws and allowing the thimble to pass. The carriage then runs along a fixed rail forming a continuation of the stationary cable, and leading to the loading or dumping station. In starting, the bucket is pushed off the rail onto the cable, and the button on the traction rope throws up the first jaw of the grip and then strikes the face of the second jaw, and carries the bucket along. The driving pulleys have gripping jaws around their entire circumference. The Exposition line had its upper terminal at the southwest corner of the Mining Building, and the lower terminal beyond the Pennsylvania R. R. building, the cables crossing the Intramural Ry. The stationary rope and the rollers for the traction rope are supported by riveted lattice columns. The lug grip illustrated in Fig. 2 was used, and ore buckets, tanks, and barrel carriers was run on the line, while at the lower terminal were switches to run the cars upon side tracks.

The company has erected a number of the Bleichert lines, under the American patents, but they are not all on heavy grades. One built for the Old Dominion Copper Co., of Globe, Ariz., has a fall of only 100 ft. in 1,250 ft., but this grade is sufficient to run the line automatically by gravity on a daily output of 100 tons. The ordinary span between the bents supporting the cables is 150 to 200 ft., but spans of 1,000 ft. and 2,000 ft. are used exceptionally, and in crossing ridges light trestles with fixed rails are sometimes used instead of cables. Lines have been built from 250 ft. to 3½ miles in length, with differences in level of 20 to 4,920 ft., the former being on a line 250 ft. long and the latter on a line 10,450 ft. long in South America. In the Acme steel tramway, which is a special type introduced by the Trenton Iron Co., the supporting track is double, and consists of flat steel bands forming flexible rails, which can be rolled in lengths of 300 ft. and coiled for shipment. In case of heavy loads they are doubled or trebled, the bands being laid one upon the other and united at intervals by suitable clips. The cars have four small flanged wheels on the top, and similar wheels on the bottom to run on narrow gage tracks at the terminals. The traction rope grip may be attached to the top or bottom of the cars. One of these lines, at Port Kennedy, Pa., has a length of 1,450 ft., and the cars have drop bottoms for discharging stone from a quarry. Underneath the Mining Building the company had a mine tunnel fitted with cable haulage for the cars on a track of 24-in. gage. The hauling part of the cable is between the rails, supported by sheaves on curves and by rollers on tangents, while the return part of the rope is carried along one side of the roof of the tunnel, with a weighted sheave hung on it to take up the slack. At the farther end of the tunnel the rope is led down to a pulley under the rails. The cable was hauled by a winding engine furnished by the Chicago Iron Works. In its exhibit in the Transportation Building the company showed the Locke-Miller cable hoist and rope carrier, used for cableways where the bucket or load has to be raised and lowered as well as hauled (Eng. News, Nov. 14, 1891).

J. Pohlig, of Cologne and Brussels, had in the Transportation Building a full size exhibit of the Otto system of wire tramway, which is in extensive use abroad, but has not yet been introduced in this country. This is a double rope system, and the line in use for carrying ore at the Garrucha iron mines, in Spain, was described and illustrated in our issue of July 25, 1891. For ordinary grades, up to 25%, a friction grip is used, the rope being held between two vertical disks, one fixed and the other movable. For steeper grades steel lugs or thimbles are attached to the rope at intervals, having inner ribs which interlock with the wire strands and so prevent slipping. The grip has two vertically moving jaws, which have sloping surfaces at the outer ends, somewhat as in the Bleichert grip (Fig. 2). When the bucket is run along the fixed rail at the starting side of the terminal to be attached to the cable, the lug on the cable throws up the first jaw by striking the sloping face, and then bears against the inner vertical face of the second jaw. The lug strikes a bell at the terminal, giving a signal to the man in charge to give the bucket a starting push to relieve the sudden shock on the rope and grip. At the arrival side of the terminal a fixed guide raises the jaw, thus releasing the bucket, which runs along the fixed elevated rail to the dumping or loading station, and thence round to the starting side for another trip. The spans between supporting trestle bents can be as much as 1,600 ft., or even more in exceptional cases. Over 500 lines on this system have been built since 1873. One of these, in Silesia, is 8,694 ft. long, and carries 700 tons of coal per day of ten hours.

J. H. Lancaster, of New York, N. Y., shows a form of carriage and grapple used with suspension cableways for hoisting and hauling sand, gravel, phosphate rock, etc.

THE IMPROVED SEWAGE DISPOSAL SYSTEM OF MILWAUKEE.

Many cities are so situated as to render the final disposal of their sewage a difficult problem. Either there is no water near at hand, into which sewage may be discharged, or else such water has become, or sooner or later will become, so polluted as to become a nuisance and menace the public health. Under such conditions the sewage may either be purified, conveyed to suitable water, or, in special cases, the volume and velocity of the stream receiving the sewage may be increased by pumping in fresh water. Among several large American cities which have at least largely improved upon their former methods of sewage disposal Milwaukee ranks high both in interest and the success with which the problem has been solved. In our issue of March 8, 1890, we described the immense low lift screw pumping engine which this city has provided to force pure lake water into the Milwaukee River, thus diluting the sewage-polluted stream and forcing it out into the lake without allowing it to stagnate and putrefy. This plant was described before that section of the International Engineering Congress in charge of the American Society of Civil Engineers by Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., who is city engineer of Milwaukee, and has been the responsible head in carrying out this and other improvements connected with the sewerage system. In addition to the flushing works Mr. Benzenberg described the general sewerage system of the city.

The present population of Milwaukee is about 240,000. The city is on the west shore of Lake Michigan, has a length of 6½ miles north and south along the lake front, a maximum width of 4½ miles and an area of 21 sq. miles. Three rivers converging in a common outlet about half way between the north and south limits divide the city in four unequal natural divisions. Of the total area of the city, 40% drains into the Malwaukee River through 47 outlet sewers; and 42% of the area now drains into the Menominee Valley through 17 main sewers.

The sewerage system embraces a total of 226.41 miles of sewers, on the combined plan, against 229.14 miles of water mains, and has cost $2,888,978. Its construction was started in 1859 after plans by the late E. S. Chesbrough, M. Am. Soc. C. E.

With the growth of the sewerage system the sluggish waters of the Milwaukee and Menominee rivers, and the canals in their valleys, became more and more offensive. In 1881 there was begun an intercepting sewer in the Menominee Valley, the section nearest the lake, 4,300 ft. in length, being put under construction. Mr. Benzenberg, upon assuming his present office of city engineer in 1882, changed the size, grade and location of the unfinished part of this sewer, in order to permit of submerged connections with the canals, so as to utilize the excess capacity of the intercepting sewers to dilute the sewage on its way to the lake, at the same time increasing the circulation in the canals. The balance of the sewer was, therefore, generally made 5½ ft. in diameter, like the lower section, while the material was changed from 8-in. beveled timbers to brick. The sewer has two river crossings, consisting of wrought iron inverted siphons. The Milwaukee River crossing, leading to the pump well, is 50 ins. in diameter, 520 ft. long, 26½ ft. below the river surface and has steel and brick-lined shafts on each side of the river. This was laid in 1884. A crossing 24 ft. beneath the water surface of the north Menominee channel, laid in 1888, is 200 ft. long and 40 ins. in diameter. It has unequal legs and forms several angles in crossing to avoid a bridge pier. At its upper end it has a submerged connection with the channel in order to prevent stagnation in the latter and provide for flushing the siphon.

There now discharge into this sewer 12 main sewers. Each of these is so arranged that the dry weather flow drops into a transverse channel leading to the intercepting sewer; but the storm water flow, by reason of increased velocity and volume, is carried over the transverse channel and empties into the streams which originally received all the sewage. The accompanying plan and section shows the first of these connections, built in 1887. Although frequently inspected, this connection has required no repairs.

The submerged connections with the canals are controlled by valves, and the capacity of the intercepting sewer is always utilized to carry as great an amount of water as is possible.

At the outlet of the intercepting sewer a centrifugal pump lifts the sewage for discharge into the

lake, the average lift for the past six years having been 15 ft., and the average discharge about 39,000 gallons per minute. This pumping engine was designed by Mr. Edwin Reynolds, M. Am. Soc. M. E., and was built by the E. P. Allis Co., of Milwaukee. It has a daily capacity, with an 18-ft. lift, of 70,000,000 gallons. The crank and flywheel of the engine move in a horizontal plane. The pump disk is 12 ft. in diameter and has a speed of 65 to 70 revs. per minute. The sewage is discharged into a 6-ft. brick conduit leading to a weir, from which it passes to the lake. The pump was started Aug. 1, 1885, and has been operated continuously since, with the exception of a few weeks for examination each spring. The average annual duty has never been below 58,000,000 ft.-lbs. per 100 lbs. of coal consumed, without any deductions. About 18% of the average daily pumpage of 56,000,000 gallons is sewage and the balance river and canal water taken in for dilution.

As stated above, the Milwaukee River flushing works were described in our issue of March 8, 1890. Briefly described, they consist of a tunnel 12 ft. in diameter and 2,500 ft. long, leading from Lake Michigan to the Milwaukee River, at a point some distance above its mouth. At the lake is located a screw propeller pumping engine with the enormous daily capacity of 500,000,000 gallons, and this forces a great stream of pure lake water through the tunnel to the river.

Thus, the sewage-polluted water of the latter is not only diluted and caused to flow out into the lake, but its temperature is reduced in the summer, and the offensive decomposition that would otherwise arise is prevented. The pump is not run during cold weather.

The entire cost of this flushing works plant was about $223,000, which is said to be less than the amount of one year's interest on the estimated cost of a system of intercepting sewers for the Milwaukee River valley. The annual operating expenses have never exceeded $25,000. The lift of the pump is very low. At the official test in December, 1888, it was only 3.05 ft. The average duty of the engine during its last year's run was 74,654,440 ft.-lbs., without deductions for steam heating or for operating a 25-light electrical dynamo.

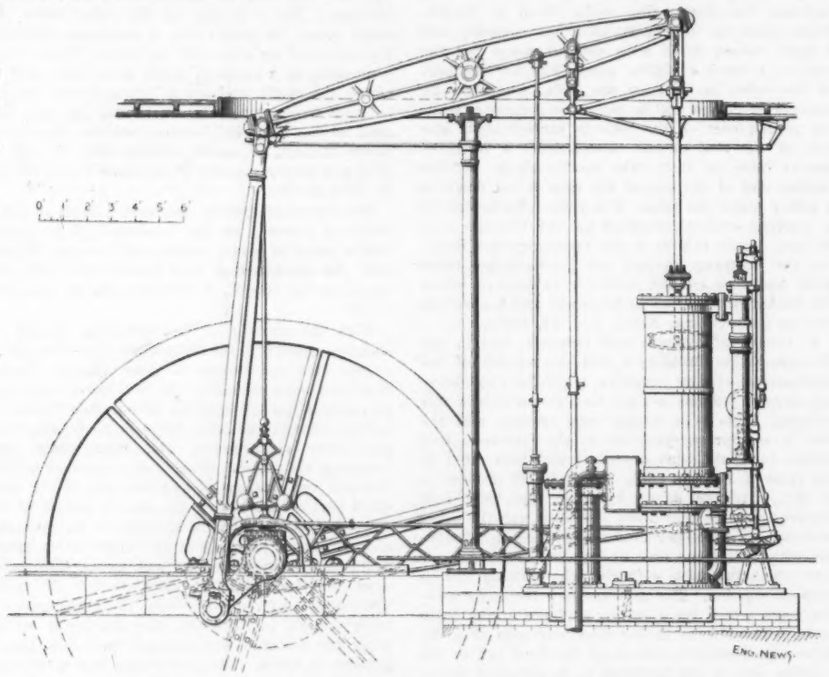
Both of the rivers and also the canals have been greatly improved since the works described above were carried out. The organic matter deposited in the canals is gradually decomposing, but without the offensive smell which was present before the circulation of the water in the canal was improved.

THE OLDEST STEAM ENGINE IN THE UNITED STATES.

The steam engine shown in the accompanying drawing was built in 1815, by James Watt, of Lancashire, England, according to the information furnished us. This probably means that it was built by the firm of Boulton & Watt, formed by the sons of the great inventor and his partner to succeed the original and famous firm of Boulton & Watt, which terminated its existence in the first year of the present century. The engine illustrated was brought to Savannah in 1815, and was set up in the rice mill of Messrs. McAlpin & McInnis. It has been at work regularly ever since and is still doing daily duty, having been put in good repair two years ago by the Novelty Iron Works, of Savannah.

The engine runs at about 18 revs. per minute and develops about 90 HP. Its cylinder is 31 × 72 ins. and it uses steam at 8 lbs. pressure. The air pump and boiler feed pump are each worked from the beam of the engine. The crank, the shaft and the connecting rod are made of cast iron.

There is good reason to believe that this engine is the oldest steam engine in the United States that is still doing regular service, and it is quite possible that it is as old as any of those which



STEAM ENGINE BUILT IN 1815 BY BOULTON & WATT, NOW WORKING AT SAVANNAH, GA.

are still preserved as curiosities. In 1803 (see Jour. Franklin Inst., October, 1876), there were only five steam engines in the United States, of which two were at Philadelphia, two in New York and one in Boston. Three of these were pumping engines.

Remembering that in 1815 manufacturing industries were still confined to the thirteen original states, and that in any of the Northern states an old machine would be much more likely to be replaced by a new one than in the South, it seems altogether likely that this is the oldest engine at work in the United States, or, for that matter, anywhere in the world save in Europe. If there be an older one in existence we shall be pleased to make record of it. We are indebted to Messrs. John Rourke & Son, proprietors of the Novelty Iron Works, of Savannah, for the drawing from which our illustration is made and the information given above.

CHERT ROADS AT BIRMINGHAM, ALABAMA.

By Julian Kendrick, City Engineer.

There has been much written lately regarding chert and its merits as a roadbuilding material. It has been classified all the way from furnace slag to quartz, and there seems to be as wide a difference of opinion as to where and how it is used. The following cities have been mentioned as using it: Atlanta, Ga., has no chert roads; Macon, Ga., has two blocks of chert street; Savannah, Ga., only a small area recently built; Montgomery, Ala., has about seven miles of county road, the bulk of which has been completed within the last three or four months, and all the chert used was taken from this neighborhood.

Chert has been defined by Mr. Eugene Smith, State Geologist of Alabama, as follows: "Chert or flint is simply silica in an amorphous or uncrystalline condition." The chert used so largely in this section in the construction of roads and streets varies in appearance from pure limestone to pure sandstone, but it is the medium between these two which makes the best roads. In color it ranges from pure white to milky blue, and in texture from porous to flinty. It abounds in cleavage joints, which seem to extend in every direction throughout the entire mass. Its geological position throughout this section is in the Trenton and sub-carboniferous formations, but it is the latter which makes the best roads. It is found in inexhaustible supply overlying the red sandstone, which forms the covering for the big vein of red hematite iron ore, and underlying the sub-carboniferous limestone. Geographically, it is found on the southeast slope of Red Mountain, a ridge extending northeast and southwest through the northern portion of Alabama, passing along the southern corporate limit of the east of Birmingham.

I have not seen Birmingham mentioned in connection with the use of this material for road-building, although it is situated in the center of the chert-producing region, the north and south highlands each being built on chert ridges, and the city having within its corporate limits 35 miles of streets, averaging 56 ft. in width between curbs, and the county of Jefferson having 175 miles of road from 16 to 24 ft. in width, all of which are built of chert.

So far as known, chert was first used in the construction of roads in 1887, at Gate City, five miles east of Birmingham, when the Gate City Land Co. macadamized about one mile of street with it, obtaining the material from just under the ledge of limestone which they were quarrying for use as flux in the blast furnace of this district. This piece of road is a part of the county road and it has since been extended in both directions by using the same material. It has been in constant use ever since with little or no repairs, and is in good condition today, although there is as heavy traffic over it as on any road in the county.

In the latter part of 1887 or 1888, the city of Birmingham began using chert on the streets. Many of them had been previously macadamized with furnace slag and they were now covered with from 3 to 4 ins. of chert, which was readily ground fine by the traffic and became so cemented as to present a smooth and very solid surface. Where traffic is the heaviest, adjoining the area paved with granite blocks, about 9 ins. of furnace slag is used as a foundation and 4 to 5 ins. of chert in the center and 2 to 3 ins. at the curb. We use slag as a foundation on account of its cheapness, the only expense being for hauling, spreading and rolling, which costs from 30 to 40 cts. per cu. yd. The average cost of chert is 80 cts. per cu. yd. on the completed street. Where travel is light the thickness of the material is reduced, and in the residence portions of the city, which are built on chert ridges, although the quality is not sufficiently pure to be used in street construction, from 3 to 5 ins. of chert on the graded street makes an excellent driveway. The streets after being so paved or macadamized are easily kept in repair. When a hole or rut occurs all that is required to repair it is to fill it with chert which combines under traffic with the old surface so thoroughly that in a short time the entire surface is the same. Should the surface wear and the foundation begin showing through it, a layer of chert a few inches thick spread over this and rolled readily combines with the old surface and cements itself into a solid mass. If slightly sprinkled before rolling the cementing is more thoroughly and quickly accomplished.

Chert seems to give an excellent surface on any good foundation, or by making it thicker it may be

used without a foundation. Hence distant points are enabled to use whatever is cheapest for them as a foundation, and the chert only as a wearing surface. The cost of chert on board cars at the pits is 25 cts. per cu. yd., or less.

I do not pretend to say that our roads compare with those paved with asphalt, but they are most excellent macadam roads, are very cheap, wear well, have less dust than such roads usually have and are much smoother than roads built entirely of limestone.

The county roads are from 16 to 24 ft. wide, as already stated, and are built as follows: Upon the subgrade limestone crushed to pass through a 2-in. ring is spread 9 ins. thick in the center and 6 ins. thick at the edge. Over this is spread a layer of chert from 3 to 4 ins. thick, which under traffic soon becomes a smooth cemented driveway.

A SERIOUS BOILER EXPLOSION.

A 50-HP. horizontal tubular boiler in the stables of the Dry Dock & East Broadway Horse Car Co., on East Fourteenth St., New York city, exploded on Nov. 2, killing five persons, injuring twelve and doing damage estimated at $40,000. An examination of the wreck was made by a member of the staff of this journal, and the facts bearing on the case have been carefully gleaned.

The boiler was built by the Bridgeport Boiler Works, of Bridgeport, Conn., about ten years ago, and was of the Lowe pattern. The accompanying illustration shows the general construction of the boiler. It will be seen that the boiler has an internal combustion chamber from which tubes extend to the end as in the locomotive type. The hot gases from the fire enter this combustion chamber through circular openings, one on each side, pass through the tubes, then down underneath the boiler, back to a point opposite the steam dome and up through flues on each side to the top of the boiler and thence to the chimney.

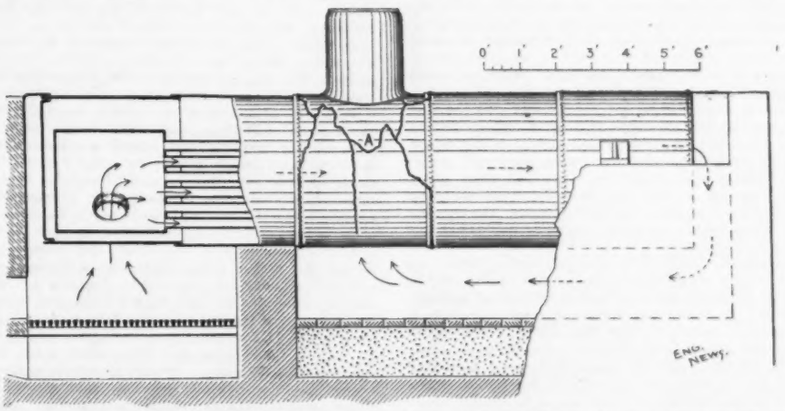
The boiler was used to furnish steam for a small engine which drove a mill for grinding feed, and furnished power for the repair shop on the top floor. It was ordinarily used only about two days in the week. The boiler was inspected and tested by a boiler inspector of the Police Department in April last, and was licensed to carry 90 lbs. pressure.

Our investigation after the explosion revealed the following facts: The sheet to which the steam dome was attached was originally 0.29 in. thick, whereas the other plates in the boiler were only ¼ in. thick, the intention being apparently to make this sheet stronger on account of the attachment of the steam dome. Had it not been for this precaution, the boiler would have failed sooner, for the plate showed that external corrosion had reduced the thickness of the sheet at about the point marked A in our drawing more than one-half, so that it was only about ⅛ in. thick. The cause of this corrosion can only be conjectured, but it seems most probable that leakage from the steam dome or its attachments, or possibly moisture descending the chimney in rainy weather when the boiler was not in use, was sufficient to wet the ash, soot, etc., which was deposited on the sheet at this point by the gases passing over it to the chimney.

Whatever the cause, the corrosion and thinning of the sheet was evident, and it was undoubtedly at this point that the fracture first occurred. At points along the fractured edge places as thin as 3-64 in. were to be found; but this excessive thinness may have been due to some extent to the reduction of section by stretching in rupture. The sequence of events in the explosion was probably as follows: The corroded metal in the sheet below the steam dome was strained to about its ultimate strength. The slight shock caused by the engineer's opening the throttle valve at the end of the noon hour was the last touch to the long overloaded metal. It parted along the ragged line just below the point A and the outrushing steam and water bent the flap-shaped piece sharply upward against the steam dome, the bend being so abrupt, in fact, as to crack the sheet through at the point of flexure. But quickly as this opening was made, it was not quick enough to relieve the other parts of the boiler from the strain; the ragged tear extended to the riveted joint on each side, and this single riveted joint tore like a sheet of paper, following precisely the center line of the rivets clear around the boiler. The reaction of the mass of steam issuing downward threw the whole boiler bodily upward and the steam dome struck the wooden joists of the ceiling overhead with a force which shattered them to splinters. But, simultaneously with this, the tearing out of the middle sheet left the two ends of the 18-ft. shell held together only by the tubes. These were instantly pulled from the tube sheets, and the two ends of the boiler, raised from their setting by the uplifting force of the steam issuing from the central break, were fired like two huge projectiles in opposite directions. Either from its lighter weight, or from less resistance of its setting, the firebox end was tilted higher than the other when the boiler was lifted. Hence it started on its flight with an upward inclination, went through the front of the building, rose high in the air, and struck with great force a building on the opposite side of the street.

The opposite end of the boiler went only a few feet when it struck the base of a heavy brick wall and its further progress was stopped.

The Chief of the Bureau of Boiler Inspection of the Police Department is reported as saying that the cause of the explosion was undoubtedly low water. Our investigation showed the end of the boiler containing the combustion chamber to be in substantially perfect condition. The crownsheet and all its stays were in place absolutely uninjured, and showed no signs of having been overheated. As overheating due to low water would certainly show itself at this end next the furnace had it occurred, it seems safe to say that low water had nothing to do with the explosion. We have briefly commented on the disaster in our editorial columns.



LOWE TUBULAR BOILER AT STABLES OF DRY DOCK & EAST BROADWAY RY. CO., NEW YORK CITY. EXPLODED NOV. 2, 1893.

PERSONALS.

Mr. B. C. Briggs has been appointed Assistant City Engineer of Erie, Pa.

Mr. Charles Martin, civil engineer and inventor of an ammonia motor for street railways, died at Bay City, Mich., Oct. 30.

Mr. W. C. Farrington has been appointed General Manager of the Eastern Minnesota Ry., with headquarters at Duluth, Minn.

Mr. Jacob Wilson, one of the contractors on the construction of the Western Maryland R. R., died at Westminster, Md., at the age of 71.

Mr. C. M. Lawler has been appointed General Superintendent of the Philadelphia, Reading & New England R. R., with headquarters at Hartford, Conn.

Mr. G. W. Vaughn, Chief Engineer of the Santa Fe, Prescott & Phoenix R. R., has been appointed General Manager of the road, retaining also his position as engineer.

Mr. A. W. Johnston has been appointed General Superintendent of the New York, Chicago & St. Louis R. R., with headquarters at Cleveland, O., and Mr. W. L. Blair has been appointed to succeed his as Superintendent of the Eastern Division.

Dr. Alfred Ludlow-Carroll, a physician and writer on sanitary and medical matters, died in New York city Oct. 30, at the age of 60. Among his writings were works on "Typhoid," "Sewage Disposal and Water Supply," "Questions of Quarantine" and "Relation of Hygiene to Therapeutics."

Mr. Willis C. Squire, until recently connected with the editorial staff of the "Railway Age," has been engaged as Western agent for the Boston Railway Equipment Co., with office in the Phenix Building, Chicago. He was for three years Chief Engineer of the Frost Railway Lighting & Manufacturing Co., of Philadelphia, and previous to that was in the testing laboratory of the Chicago, Burlington & Quincy R. R.

NEW PUBLICATIONS.

NOVEMBER MAGAZINES.—In "Scribner's" this month is a brief editorial criticising the designers of the World's Fair buildings for having followed classic lines instead of developing a modern style. "Harper's" has several good sketches of travel. Julian Ralph describes a steamboat journey along the Bayou Teche, in Louisiana. R. W. McAdam tells of the present condition of the Indian Territory, a section of this country of whose affairs the average Eastern man knows less than he knows about the natives of Africa. Edwin Lord Weeks describes his travels in Persia, which were so sadly interrupted by the death of his companion, the late Theodore Child. Mr. F. R. Coudert has an excellent paper on arbitration as a means of settling international disputes. In the "Century" Mary Hallock Foote has a prettily told story, whose hero is the "watcher" on the line of an irrigation ditch. The mode of life of the professional tramp is described by a writer who claims to have tried the life experimentally. The "California Illustrated Magazine" contains a well written paper by Wm. A. Lawson, entitled "Irrigation in California." The leading paper of the number, "Village Life in Mexico," will be of interest to American engineers who have spent some time in that picturesque country.

In "The Forum" Dr. John S. Billings writes on Municipal Sanitation in New York and Brooklyn. He makes the interesting statement that the ancient topography of these cities can be traced to this day in their death records. "The old marshes and streams which have been filled in or covered so long that very few remember their existence still indicate their effects on the mortality of their ancient sites, especially in the death rates from malarial fevers, pneumonia and diarrhoeal diseases." Prof. John R. Procter, Director of the Kentucky Geological Survey, discusses "America's Battle for Commercial Supremacy." He looks forward to seeing America take the lead of England as a producer of coal, iron and cotton goods.

In the "Review of Reviews" Mr. S. A. Thompson, Secretary of the Duluth Chamber of Commerce, writes of "Possibilities of the Great Northwest," including in the term the Canadian Northwest and the states of Minnesota, Iowa, the Dakotas, Nebraska, Montana, Wyoming, Idaho, Washington and Oregon. He begins his paper with the following quotation from a letter written by the officer in command of Fort Dearborn, on the site of the present city of Chicago just 70 years ago:

> I respectfully recommend that this post be abandoned, for the reason that the surrounding country is of such a character that it is impossible that it can ever support a sufficient population to justify the expense necessary to maintain a fort at this point.

Probably the very street urchins in Chicago are familiar with this scrap of history; but it may be new to some of our Eastern readers, all the same. A paper on a topic closely connected with the above is entitled "Inland Waterways for the Northwest." Prof. E. Benjamin Andrews, of Brown University, writes on "The Future of Silver Production." He thinks that the climax in silver production has been reached, and that even with a free coinage ratio of 20 to 1 this country

would be in no danger of losing its gold supply. In "The North American Review" Gov. Roswell P. Flower, of New York, gives his opinions on "How to Improve Our Roads." He opposes highway building by the state or the nation, but thinks the principal highways should be made and maintained by the counties rather than by the towns. William A. Pinkerton writes on train robberies, and strongly urges the passage of the bill now before Congress making train robbery an offense punishable by United States law. He declares that train robbery is on the increase, and that unless stringent measures are taken for its suppression he would not be surprised to see express trains held up within ten miles of New York or Philadelphia at no remote date. In "The Popular Science Monthly" we find an illustrated description of modern methods of oyster culture, and a discussion of the origin of the Mississippi Valley rainfall which will interest meteorologists. The October "Nineteenth Century" has a paper on "The Position of Geology," by Professor Prestwich, in which the extreme positions of both the Uniformitarians and the Physicists are condemned.

THE TRANSITION CURVE, by Offsets and by Deflection Angles. By C. L. Crandall, C. E., and Prof. C. E., Cornell Univ. New York: John Wiley & Sons. 12mo., pp. 64. $1.

This work gives a good and sensible process of laying out transition curves, the most so of any book now in print, so far as we can recall, since it is the only one which possesses an indispensable requisite for any really adequate method of laying out these curves, viz., the ability to choose any length and offset which chances to fit the ground best, or the line as located, or the available length of tangent or curve. This is made a more than usually valuable property, because the author has so worked up his problem that his results are accurate for any length of curve whatever; and he correctly states that it is often convenient or useful to use much longer curves than would usually be required to suit special conditions.

The book is so good that we regret it is not better, and we urgently advise the author to recast a few pages, add a number of new ones, and make a few slight changes in the rest; in which case we think this work might prove entirely adequate for the student and worker in these particular problems, and monopolize the field.

Our general criticism is that the author either has not the gift or does not realize the importance of seeking extreme clearness and simplicity of arrangement in all books of reference, and especially in a field-book, which the suffering youth at the transit has to use quickly and with certainty, while his party stands by idle, perhaps, inwardly guying him; and hence has to use with a particular liability to confusion and mistake.

To particularize, beginning from the back: The three important tables, I., II., III., are all of them headed by letters only, the meaning of which there is nothing in the vicinity nor in any specified part of the work to shed any light upon. In examining the volume we at first supposed that paragraph 6 gave the only explanation of the tables; but on the more careful examination found that there was a fuller explanation on pages 35-6. This should be distinctly referred to, and it should be somewhat amended, we think, as below noted; and paragraph 6 itself should, by all means, be so recast as to be complete and sufficient unto itself as an explanation of what the letters in the table means, without the necessity of turning elsewhere; as it is extremely likely to be turned to for explanation of the tables, and by itself is a mere unintelligible jumble of letters, really to comprehend, which requires a search for each letter's meaning further back. But even if this be done there is blank space enough in connection with Table III. to give a little cut right on the page, showing at once what all the letters mean; thus making it convenient in itself for immediate use.

Table II. is one to facilitate determining co-ordinates. As at once concise, precise and remarkably general, it is an extremely good one; but if we turn to paragraph 6 to see what it means, we find only:

> Table II. gives C of (4) and (E) of (6), rendering the computation of the co-ordinates 4 and 7 of any point in the curve extremely simple.

Yes; precisely! But if the fellow who wants to use that table without an instant's delay doesn't feel moved to throw both the C of (4) and the E of (6) at the head of the author when he lights upon that lucid explanation, he will be different from the men we used to know in the field. And then, what is the argument to the table? It is not stated in the above quotation. If the inquirer has chanced to turn to page 36 for information he will find this defined, but in a way hardly clear enough for ready comprehension of what "n" is; which is, any given fraction of the length of the curve.

Table I. is still more in need of an explanatory diagram in its immediate vicinity. The lower part of page 38 gives room for it; and if found necessary the whole page might well be used for it, as it is hardly important to keep the curve notes of transition curves in extenso, for the curve may be recovered at any time in all its parts from given values of I, l and F.

Turning now to the beginning of the book we have not a word of fault to find with our author's exposition of the theory of the curve, except this: Rigorous theoretical analysis leading to accurate values under all conceivable conditions, unsupplemented by certain practical expositions of its true nature, tends to make the curve a sort of "d— barren ideality" in the mind of a student and nothing more. He does not really grasp its nature and general laws. He comprehends it through mathematical facilities only, not through the geometric perceptions. This is to be avoided, because it tends to practical error if for no other reason. The author should precede or follow paragraph 6 by a further exposition, showing how in all ordinary cases, for moderate lengths and effects, the curve reduces to much simpler laws and formulas than those which are invariably precise; that it is sensibly a cubic parabola; that the curve always sensibly bisects the total offset F; that the offsets to the curve from the tangent and the circular curve are sensibly equal at equal distances from the extremity of the curve; that the offsets at the quarter points are always sensibly 1-16 F, or almost evanescent; so that for grading purposes it is rarely more than half as long in fact as it is in theory; that the track-centers as well as the grading centers may be laid out by offsets only in all ordinary cases, with sensibly perfect accuracy. By explaining (and perhaps by studying) the curve from this point of view the author will greatly increase the utility and also the sale of his book, and the credit which will accrue to him therefrom, among practicing engineers at least, if not among instructors, who are somewhat too much given to insisting on rigid precision as the first essential, or even in some cases, as the only essential.

Again, in paragraph 9, the author implies, and we think justly, that in general, when circumstances permit, the best way for determining a transition curve is to assume a length, and let the offset F at the P. C. come what it will. But in many cases, as he recognizes elsewhere, it is impossible or inexpedient to assume a length. The practical case is that we have given or must fix the offset F, and fit in a curve to suit that. Right here, therefore, and perhaps also among the tables, there should be a demonstration and table showing the equivalency of offsets, and bringing out saliently the fact that they should vary approximately as the cube of the degree of curvature; so that if 1 ft. be regarded as a suitable offset for a 2° curve, 1,000 times that offset gives a no easier approach to a 20° curve. Technical writers should not neglect to bring out all such important relationships clearly and specifically, simply because they may be deduced by a sufficiently careful student from what is given. Without an all-around grasp of all such fundamental facts, how can a man act intelligently in the field, however clear he may be in respect to the bare mathematical processes?

On the same principle, the application of transition to compound curves in paragraph 10 should begin with an exposition of the general fact that in all essentials of lengths and offsets the transition curve to connect a D° and D'° curve is identical with one connecting a tangent with a (D'—D)° curve. The student then grasps this salient fact; proceeding from the simple to the more complex; and never forgets it. As the differences of curvature in most such cases are comparatively small, and the transit work, if rigorously done, becomes more complex, the offset method is particularly suitable for such curves. This should be made clear.

The description of the offset method on page 14 is a good illustration of some matters of form we object to. It reads:

> Assume a suitable l' (or F') for D—D' curve: take out the corresponding F (or l) and e + e' from Table I., etc.

This style is perfectly suitable in those parts of a treatise which are only meant to be studied at leisure and continuously for technical instruction; but in sentences purporting to give "the conclusion of the whole matter" for practical use in the field they are needless annoyance. It is just as easy and about as concise to say "length" for "l," "offset" for "F" and "length correction" for "e + e'"; or still better, to say both together.

In the middle of page 10 there is a "suggestio falsi" in the statement that intermediate points on the curve may be obtained by offsets "near enough during construction"; and in the following numerical example for a pretty extreme case of transition curve, wherein offsets thus computed are given numerically, with the added statement that "the true co-ordinates can be computed by (4) and (6) if needed for greater accuracy." Did the author take the trouble to determine that even in this extreme case the difference between the precise and the approximate value is so very minute that no one having a comprehending grasp of track work would have any possible use for the "greater accuracy?" If so, why does he not state it? And why does he not also state that 99 curves in 100 would stand even less in need of this "greater accuracy" than the example given?

The effect of omitting to give such practical information to practical men is simply this: The whilom docile and receptive student gets out into the world, and begins to do work for himself. He soon begins to get to the bottom of things by practical experience. He soon distinctly perceives that much of this sort of hair-splitting in the text-books is, in his own expressive phrase, "poppy-cock," leading to much work for no gain. Hence he too often gets a certain contempt for theories and theorists, which does him the ill-turn of leading him to neglect them until perchance he is unable to avail himself of their assistance when he most needs it from lack of use. Remembering that all geometric work in engineering is only the skeleton, so as to speak, in clothing with which the flesh of utility true engineering capacity is chiefly needed and displayed, all good engineering works will carefully subordinate geometry to useful results, remembering that in engineering work proper precision is not the end, but only a means to an end; and only as it is such, is useful.

We trust it will be perceived that we have criticised this book in a friendly spirit; because it is so good as to deserve careful criticism, and in the hope of making it better, and not because it is in any sense bad. On the contrary, we again commend it as by far the best book on the subject, and as the one best deserving to be used by all colleges as a text-book for the instruction of students.

We disapprove of the way in which the decimal point has been omitted at the top of columns e and e' in Table I., as tending to confusion.

TELEPHONY.—A Manual of. By William Henry Preece, F. R. S., Engineer-in-Chief and Electrician General Post Office, and Arthur J. Stubbs, Technical Officer General Post Office. London: Whittaker & Co. New York: Macmillan & Co. 12mo; pp. 508; illustrated; $4.50.

This is an exhaustive treatise on the telephone, dealing with its principle, construction, installation and general application to the electrical reproduction of speech. After an introductory sketch of the evolution of the telephone, the authors describe the effect due to induced currents and then take up the theory of the Bell telephone and its improvements, the Edison transmitter and the Hughes microphone. Following chapters deal with telephone receivers of various types; carbon transmitters; early examples of telephonic research, commencing with the Reis telephone of 1860; the efficiency of transmitters and induction coils, and complementary apparatus used with telephones, such as batteries, lightning protectors, cut-outs, bells, etc. Chapter IX. describes complete telephone instruments of various types. Part III. treats of the simple telephone exchange systems, and Part IV. of multiple switches. Part V. is devoted to miscellaneous switching and other systems, and the last portion of the work relates to the construction of the lines, to their wires, cables, tools used, etc. The text is very fully illustrated, and every detail of theory and practice seems to be most exhaustively treated.

MASTER CAR BUILDERS' ASSOCIATION. Report of Proceedings of 27th Annual Convention at Lakewood, N. Y. Published by the Association. Jno. W. Cloud, Secy., Rookery Building, Chicago. 8vo; paper; pp. 409; illustrated.

This is a report of one of the most interesting and valuable meetings that the Association has ever held. The complete illustrated report of the official coupler test and the report of the committee on air-brake tests, are probably the most important of the contents of the volume. A condensed report of the convention was given in our issue of June 22.

TRADE PUBLICATIONS.

PUMPS.—Jas. Simpson & Co., Ltd., Engine Works, London. Pamph.; pp. 143; numerous plates and illustrations in the text.

This firm makes all types of steam engines and pumping engines for various purposes, including rotating and Worthington direct-acting. Aside from descriptive matter and testimonials the pamphlet gives seven reports on pumping engine trials, one of which is by Prof. W. C. Unwin.

THE NEW YORK FILTER.—New York Filter Co., 143 Broadway, New York City. Pamph.; pp. 100; illustrations.

This company owns the patents of the Hyatt Pure Water Co., U. S. Pure Water Supply Co., National Water Purifying Co., American Filter Co. and the Blessing Filter. The catalogue describes and illustrates the filters now being made by the company, which, in the larger sizes, it appears, are chiefly of the horizontal type, using sand and coke as a filtering material, alum as a coagulent when necessary, and sectional washing by means of reversing the flow of water through the cone valves at the bottom of the filter. Both pressure and gravity filters are made, and filters can be supplied in all sizes, from those suitable to a household or manufacturing plants, to

those required for the water supply of a large city. Aerating plants are also constructed by the company.

THE SOFTENING AND FILTRATION OF WATER.—A. Howatson & Co., Engineers, Neuilly-sur-Seine, France. Pamph; pp. 8.

This illustrated pamphlet describes apparatus for filtering and softening water under patents granted to Mr. Andrew Howatson. Lime and soda, automatically admitted, with subsequent sedimentation and filtration are employed to soften water. The water filters are made both for low and high pressure, use sand as a filtering medium, sulphate of alumina or potash-alum as a congulant, and a reversed current and a revolving rake or agitator to wash the sand.

THE VENTURI METER.—Builder's Iron Foundry, Providence, R. I. Pamph.; illustrated.

This pamphlet is largely made up of a reprint of a paper on the Venturi meter, presented before the American Society of Civil Engineers in December, 1887, by Mr. Clemens Herschel, M. Am. Soc. C. E., and a reprint on the same subject from Prof. Mansfield Merriman's "Hydraulics." In addition separate descriptions of the meter and the new recording apparatus, together with tests of the latter, are given. Among the illustrations are half-tone views of the 36-in. meter which measures the water supply to the World's Columbian Exposition and a view of the recorder for the 6-in. meter which measures the Waukesha drinking-water at the same place. The meter and old form of recording apparatus were described at length in our issue of July 7, 1892. It is especially adapted to measuring very large volumes of water, sewage or other liquids.

ENGINEERING AND PHYSICS BUILDINGS. MCGILL UNIVERSITY; Montreal. Folio pamph.; pp. 68.

This pamphlet, which is nominally intended to give a description of the opening exercises of these buildings, among the best appointed of any on the continent for their use, and in some respects unique, gives also an elaborate illustrated description of the buildings, their rooms and contents. McGill University is a very live institution, and since these additions have been made to its plant for instruction in engineering it stands in the front rank of American engineering schools. Its engineering department was described and illustrated in our issue of June 1.

HOW TO SELECT DRAWING INSTRUMENTS.—The Keuffel & Esser Co., New York. 8vo; pamph.; pp. 12.

This is an instructive, if somewhat controversial, little pamphlet, quite fully illustrated with views of the more important or fundamental instruments only, and in no sense of the catalogue type. With the proviso that good material and workmanship counts for more than the particular details of joints and the like, the pamphlet seems to support the statement that it was intended to give "useful, and, above all, correct information about drawing instruments."

SOCIETY PROCEEDINGS.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Nov. 1, Professor Johnson described Colonel Flad's new suction dredge boat and presented full detailed blueprints illustrating its construction.

Arthur Thacher, Secy.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—At the meeting at Montreal on Nov. 9 a paper on "A Cubic Yard of Concrete," by H. F. Perley, was read, and the discussion on "Domestic Sanitation," by Mr. Macdougall, and on "Port Crescent Breakwater," by Mr. A. S. Going, was continued.

C. H. McLeod, Secy.

MASTER CARBUILDERS' ASSOCIATION. The 28th annual convention will be held at Congress Hall, Saratoga, N. Y., beginning Tuesday, June 12, 1894, and the convention of the Master Mechanics' Association will be held in the week following. Lithographed copies of the revised drawings showing the standards of the association may now be obtained from the Secretary, Mr. John W. Cloud, Rookery Building, Chicago.

PROCEEDINGS OF PATENT AND TRADE MARK CONGRESS.—The proceedings of this section of the World's Congress Auxiliary of the Columbian Exposition, the sessions of which were held during the first week in October, are to be published in book form, provided sufficient advance subscriptions can be secured. About 40 papers were read before the Congress, and the printed report is to be sold at $5. Subscriptions may be sent to, or further information may be obtained from, Mr. Ephraim Banning, 225 Dearborn St., Chicago.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—The autumn meeting was held in Roanoke on Oct. 27 and 28 and Nov 1, the session of Oct. 28 being followed by a dinner and a stereopticon exhibition of World's Fair views by Mr. G. R. Henderson. A memoir on the late James H. Fitts, Professor of Mechanical Engineering at the Virginia Agricultural and Mechanical College, at Blacksburg, and Vice-President of the Association, was presented by Mr. H. A. Gillis.

The main business of the meeting was the discussion of a report by a special committee appointed at the summer meeting to frame a set of building laws for the city of Roanoke. The report as adopted provides not only for the strength and stability of buildings and their safety from fire, but also provides for sanitary safety and makes rules for the proper enforcement of the laws. While designed primarily for the city of Roanoke, they can be made applicable to any town or city.

L. J. Carmalt, Secy.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Nov. 1, the president, Mr. William Metcalf, in the chair, the secretary read a paper by Mr. R. Montfort, on "Protecting Piles Against the Teredo on Structures on the Louisville & Nashville R. R.," an abstract of which was printed in our issue of Oct. 19. To the paper was appended a statement of the damage done along the Gulf coast lines of the L. & N. R. R. during the hurricane of Oct. 2. Mr. Geo. H. Thomson said that charring is effective if the pile can be driven without breaking the charred surface. Mr. Parker referred to the fact that the teredo is rapidly disappearing from the waters around New York city owing to sewage which is discharged from outlets extended under the piers and wharves. He thought it was a question whether the teredo eats the wood for food or merely bores in it for a home. It will eat both creosoted and kyanized wood. Another member referred to the varying qualities of creosote, some of which are valueless as wood preservative, and considered naphthaline to be the worm resisting ingredient of the creosote. Wood creosote oil will not resist the teredo. He referred to the use of calcium chloride and silicate of soda, forming glass crystals in the wood, so that it cannot be burned or cut with a knife. Mr. Collingwood referred to the use of wood creosote oil at the Newport News dry dock, where it did not prove successful. Mr. Charles Macdonald considered that the paper showed that wood was not a proper or economical material under certain conditions, as where expensive preservative processes and frequent renewals are required. He had used 5-in. solid iron piles with success, and referred to the use of iron screw piles encasing wooden bearing piles at the wharf at Fort Monroe, Va. (Engineering News, June 30, 1892).

INSTITUTION OF MECHANICAL ENGINEERS.—(From our London correspondent.)—A general meeting was held in London, Oct. 25 and 26. There were two papers presented: "The Artificial Lighting of Workshops," by Mr. B. A. Dobson, and "The Working of Steam Pumps on the Russian Southwestern Ry.," by Mr. Alexander Borodin, Engineer-Director. Mr. Dobson is the employer of a very large number of men at his works at Bolton, where he is engaged in the production of textile machinery. Hitherto he has lit his works by gas, for the atmosphere in the manufacturing parts of Lancashire is so smoke-laden that there is seldom sufficient natural light for careful work. For four years in succession it has occurred that on June 21, the longest day of the year, the gas in every room of the works, amounting to nearly 7,500 jets, has had to be lighted by 11 a., m., and has remained lighted until work ceased. This has occurred also in other towns, and in weather that ought to have secured abundant sunshine. The difficulty Mr. Dobson met with in the introduction of electric light was the very deep shadows cast by the arc lamps, and incandescent lamps were not a sufficient improvement on gas. Mr. Dobson made a trip to the Continent to study the plan of inverted arc lamp illumination, which was in use in some weaving sheds near Brussels, and the results of his examination were so satisfactory that he adopted that plan. The lamp is inverted with the reflector beneath, so that the light is thrown on to the ceiling, which is kept well whitewashed, the walls of the room also being whitewashed. In this way a thoroughly diffused light is obtained. The arc lamp used has two carbons of different diameters. The negative carbon is solid and is the upper one, while the lower and positive carbon is hollow and rather larger in diameter. Their areas are 0.2 and 0.486 sq. in., respectively. These proportions insure their both consuming at the same speed, thereby avoiding the necessity for any complicated clockwork. The carbons are drawn together by a counterweight, the distance apart being regulated by a magnetic brake. The crater carbon is the lower one, so that the rays are thrown upward toward the ceiling. The building illuminated is of three stories, each room being 123 × 55 ft. It is much shut in by other edifices, so that there is very little natural light. In the bottom room there are 51 lathes, fluting machines, etc., and 60 workmen are employed in attending to them. The second room contains 164 machines and 112 workmen. For lighting the three shops there are 60 arc lamps, which, with 66 incandescent lamps, used in a pattern store, absorb 70 HP. The dynamo is of the 4-pole type. Formerly, this part of the works was lit by 502 gas jets, each burning 4 ft. per hour. Gas in Bolton costs about 66 cts. per 1,000 cu. ft., and the total cost, therefore, would be about $1.28 per hour. The cost for carbons would be 62 cts. per hour. He thought it probable that the cost of electric lighting would be more than that of gas, but the additional expense was amply warranted by the advantages gained.

It may be added that after seeing the installation at Bolton, Mr. Aspinall, Chief Managing Director of the Lancashire & Yorkshire Ry., applied a modified arrangement of this method at the railway shops at Horwich. In this case the nature of the roof prevented a solely reflected light, and Mr. Aspinall had to bring the arc lamps through large whitewashed reflectors. With the inverted lamp, having the positive carbon below, the great part of the light which proceeds from the crater is thrown upward, to be reflected back well diffused, and therefore not throwing strong shadows. The advantage in this avoidance of shadow is very great, although in this respect it is not so perfect as when a wholly reflected system is used. Mr. Aspinall stated that one lamp of 10 to 15 amperes was sufficient for an area of 151 sq. yds. As to the efficiency of the reflecting surface, many persons are under the impression that a looking glass or a bright reflector is the best that can be used, and it has been argued that because it is impossible to throw a heavy shadow by means of light reflected from paper, whereas strong shadows can be thrown by light reflected from a looking-glass, that the bright reflector must be far more efficient than the dead surface. This, however, is a fallacy, as has been shown. In the discussion which followed the reading of the paper, Mr. A. P. Trotter, a well known authority on this subject, said that clean, white blotting-paper would reflect 82% of light cast upon it. It is, however, desirable for illuminating purposes that there shall be an absence of shadows, and the imaginary nature of the advantages of a looking-glass reflector will therefore be apparent.

Mr. Borodin's paper gave the results of a number of tests of pumps of various types, mostly of English manufacture, on Russian railways. The value of the details given in the paper lies in the fact that they show how vastly actual working efficiency may differ from trial efficiencies. When we find a pumping engine giving less than 3,000 ft.-lbs. of work done per pound of steam, it will be evident that the machine must have been terribly out of order, supposing it were designed in even a moderately efficient manner.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF KANSAS CITY.
Nov. 13. Secy., Waterman Stone, Baird Building.
DENVER SOCIETY OF CIVIL ENGINEERS.
Nov. 13. Secy., F. E. King, Jacobson Block.
WISCONSIN POLYTECHNIC SOCIETY.
Nov. 13. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Nov. 14. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
Nov. 14. Secy., W. D. Crosman. Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Nov. 14. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Nov. 15. Secy., L. J. Carmalt, Roanoke, Va.
ENGINEERS' CLUB OF ST. LOUIS.
Nov. 15. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Nov. 15. Secy., F. Collingwood, 127 East 23d St., New York.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Nov. 15. Wichita, Kan.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Nov. 15. Secy., S. E. Tinkham, 36 Broomfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Nov. 15. Secy., L. V. Carmalt, Roanoke, Va.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 16. Secy., S. A. Charplot, Macon, Ga.
NEW YORK RAILROAD CLUB.
Nov. 16. Annual meeting. Secy., John A. Hill, Temple Court, New York.
ENGINEERS' CLUB OF CINCINNATI.
Nov. 16. Secy., J. F. Wilson, 94 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Nov. 16. Secy., Allen Strale, 100 Washington St.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Nov. 17. 201 Washington Building.
ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 18. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
Nov. 18. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
WESTERN RAILWAY CLUB.
Nov. 21. Secy., Clement F. Street, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Nov. 21. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Nov. 21. Secy., R. H. Clark, Pittsburg.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Dec. 1. Secy., E. E. Smoot, 806 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Dec. 1. Secy., O. Von Geldern, 719 Market St., San Francisco.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 4. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Dec. 5. Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
Dec. 6. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
Dec. 7. Secy., E. Nexsen, 504 Kasota Block.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Dec. 7. Secy., C. H. McLeod, Montreal P. Q.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Dec. 9. Secy., C. O. Foss, Helena.
NEW ENGLAND RAILROAD CLUB.
Dec. 13. Secy., F. M. Curtis, P. O. Box 1576, Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
Dec. 14. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Dec. 14. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Dec. 15. Secy., D. W. Mecker, St. Paul.
CENTRAL RAILWAY CLUB.
Jan. 24. Secy., S. W. Spear, Buffalo, N. Y.

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

A serious boiler explosion occurred in New York city last week and is described elsewhere in this issue. The cause of the explosion appears to have been external corrosion, which had reduced the thickness of part of the middle sheet of the boiler more than half. We are not informed as to the exact plan of the boiler setting; but as nearly as we can learn the corroded sheet was so inclosed by the brickwork that it could not have been reached by a boiler inspector from the outside. Vigorous hammering from the inside might have detected the dangerous thinness of the sheet; but how many inspectors are there who hammer vigorously every sheet of a boiler while they are inside it; and how large a part of the inside of an ordinary tubular boiler can an inspector reach to strike a vigorous blow upon it?

There is a widespread belief that faithful inspection is a practically perfect safeguard against boiler explosions; and the records of the best boiler inspection companies offer considerable evidence in support of that view. But to secure protection by inspection, complete inspection should be possible, and a boiler setting should be so designed that every external part of the boiler as well as the internal parts can be reached for examination. The common practice of building brick masonry flush against the shells of boilers is an objectionable one and creates perpetual uncertainty as to what inroads corrosion may have made upon the strength of the metal. It is questionable, indeed, whether there is not room for an important reform in boiler settings, and whether the tendency should not be toward light, easily removable sectional coverings of asbestos, magnesia, mineral wool, plaster of paris or other highly efficient non-conductor and away from the cumbrous and by no means inexpensive brick settings. This has already been done in some recent designs of sectional boilers, and others are likely to follow.

Another lesson from the recent explosion is the advantage of giving an ample margin of strength to all parts of a boiler, so that a local rupture may not extend. Had this boiler which failed so disastrously been built of $\frac{5}{8}$-in. steel instead of $\frac{1}{4}$-in. iron, and had its circumferential joints been double riveted instead of single riveted, the rupture would probably have been confined to the sheet in which it started, and the wreck of the building and the killed and injured in the street would have been saved.

These ideas are by no means new. The late Prof. Chas. A. Smith, in his work on "Boiler Practice," said:

> Rupture of a boiler will be followed by relief of pressure with or without explosion, as the fracture is extended or restricted. Implicit confidence cannot be placed in the hydrostatic pressure test, but it should be followed with careful inspection assisted by the sound of a blow struck with a light hammer. Many boilers have exploded when corrosion has reduced the metal to such a thickness that a smart blow from a round ended hammer would have gone through the sheet, while the boiler showed tight under hydrostatic pressure.

The soundness of these statements is well attested by last week's unfortunate disaster in East Fourteenth St.

We lately undertook for special reasons what we rarely attempt, to select an engineer for an advertised vacancy on behalf of the advertiser. In so doing we have been struck by the injudicious way in which many applicants word such letters, and possibly a hint or two on this head will not be wholly useless.

In these dull times the applicants for a desirable engagement are naturally numerous. Even in the best of times they are apt to be, because many men find themselves disengaged even then for one reason or another. Every sensible man who is disengaged at any time and for any reason desires to be re-engaged as soon as possible, and infinitely prefers to make some small sacrifice of salary with the chance of later advancement than to stand idle waiting for what may never come, a better offer.

Under these circumstances, the sensible thing for the man who is, in fact, indisposed to quibble over the salary, is to say so frankly; to state, if he will, the sum which he considers he ought to receive, and also, if he will, a minimum sum which is the least he will accept, but to add with equal frankness: "I am disengaged and desire an engagement, and am willing to accept whatever salary is deemed proper for the place (with a limitation if desired) provided it affords opportunity for advancement according to merit," or words to similar effect.

Only two or three of some 50 applicants took this course. On the contrary, the salaries asked varied almost in inverse ratio to the experience. One young man but five months out of college named $250 per month as his figure, and this with all living expenses paid, a fact which very many seemed not to take into account in naming their prices. Accordingly, many letters which might otherwise have been considered on their merits went into the waste-paper basket.

Many other applicants—a surprising number—evaded the difficulty of fixing a figure by saying nothing at all about salary, and this in spite of explicit notice that "specific statements of qualifications, experience and salary expected," would be required "to secure attention." The thought in their minds undoubtedly was, "I will put forward my qualifications, and if they pass muster, I will not stand long on salary; but I had rather not say so. My omission to do so will pass as an inadvertence." Their letters inevitably went into the waste basket. They stood revealed as either blunderingly careless or indifferent to instructions. No one publishing a specific notice of that kind is going to trouble himself to write two or three letters to get what was asked for in one. Even when the notice is not so specific as in this case, in requiring the salary expected to be distinctly stated, nine men out of ten expect the answers to be specific, and will give the preference to those which are so, and ignore those which are not.

Quite a number of others sought to temporize with the issue in this way: Without explicitly disregarding the above-quoted notice, they explained that they could not fix any specific sum without knowing more about location and climate and requested an interview or a letter of details. They got none; and deserved none. The notice had distinctly stated, "under favorable conditions in all respects." The applicant's plain duty, therefore, was to name a salary or salary limits based on the truth of this statement; thus to get "a grip" on the engagement if he could, and then only, after having the game otherwise in his own hands to satisfy himself that the alleged favorable conditions existed, or throw up the engagement. Had the ostensible motive been the real one it would have been instinctive for applicants to try thus first to catch the hare if they could, and afterward consider at leisure whether it was worth cooking or not. But it was not the real motive; it was a mere temporizing evasion which lowered them in the mind of the very man they were seeking to find favor with —the man with a vacancy to fill.

A surprising number of men also failed to give any information as to such of the qualifications asked for as they did not possess, whether stated as essentials or as merely desirable. They would tell facts which they thought were in their favor but no fact which they thought was against them; as for instance, that they had no experience in hydraulic mining or knowledge of Spanish, or no engineering education. They preferred to trust that their deficiency would pass unnoticed rather than tell the truth about it. It never does pass unnoticed; and they would create a vastly better impression if they went through the notice to which they were responding seriatim, giving specific information about their plus or minus qualifications in a few brief words, and then added a few notes which are generally not asked for but always have weight; such as age, weight, height, married or single, and the like.

If applicants would only remember that in answering such a notice each is rendering his first service to a desired employer, and would consider what kind of service employers like best, each would have an infallible guide how to write such a letter. The employer wants fidelity first and last, zeal, intelligence and quick-minded alert attention to the work in hand; and in any sort of report he wants no useless words and the fullest possible information. The applicant's letter is report No. 1 from the would-be employee. It "sizes him up" as much as any other report, and more completely than young men realize. If stating clearly all the pros and cons of the issue with apparent fairness it creates a favorable impression. If shifty, evasive or slovenly, it creates a bad one —and ends the applicant's chances.

HAS THE VALUE OF GOLD APPRECIATED?

The great Senate contest being now over, the silver question will be considered calmly on its merits hereafter, we may reasonably hope. The only reason why there is any such question, otherwise than among producers of silver, is a general belief that the value (i. e., mean purchasing power) of gold either has appreciated or will appreciate as a consequence of the displacement of silver as a primary money metal. The great and continuous fall in the prices of almost all commodities in recent years is pointed at and very generally accepted as a proof of the appreciation of gold, or at least of a tendency in that direction; and if this fact be admitted it is plainly a reasonable inference that the same tendency is likely to continue and grow stronger in the future.

On the other hand, if it be established beyond question that up to the present time there has not developed even a tendency to appreciation in the mean purchasing power of gold, but rather the contrary, it will plainly be as fair an inference that none such is likely to develop in the future from the continuation of present tendencies. We think this may be done. We shall not undertake in this article, however, to set ourselves up as prophets of the future, but confine ourselves to an effort to make clear that up to the present time the mean purchasing power of gold has neither increased nor shown a tendency to increase, in this or any country, but distinctly the contrary. This at least can be established, we think, beyond all reasonable doubt.

Before attempting this, however, we should clear away one side issue, because a theory to be correct must be consistent and reconciled with all known facts, or a logical mind will on that ground alone refuse to accept it. It may reasonably be asked: If gold has not appreciated, how is it possible that the purchasing power of its "sister metal" has so greatly decreased concurrently with the market price of most commodities? A possible explanation, which we believe to be the true one, is obvious:

Nations, like individuals, as they advance in wealth and civilization and in confidence in each other, use less and less metallic currency and more

and more checks and notes. There probably never was a time when the actual circulation of metallic currency was less per head than it is to-day among people of corresponding incomes; and with nations, as with individuals, this use tends to be rather in inverse ratio to their yearly income than the contrary. More and more daily even gold is ceasing to pass from hand to hand, and is stored away to serve as a standard of value only or (to a decreasing and partial extent) for settling international balances, which latter also bid fair soon to be settled mainly by paper evidences of indebtedness; if, indeed, they are not now.

In the meantime, this decrease in need for metallic currency has been accompanied by a three-fold increase in the total gold supply since 1850. Gold being intrinsically by far the better metal of the two for use as money, and the yearly supply of gold alone being large and increasing, it is at least possible that the civilized world perceives that gold alone, with a moderate amount of silver change, will supply its present and prospective needs for metallic currency; and therefore declines to have anything more to do with the baser metal, except for spoons. In this displacement of any metal from a use to which it was formerly devoted, there is nothing either surprising or alarming. Precisely the same thing in effect (the displacement of a poorer by a better material as soon as the supply of the better is sufficient) has happened to wrought iron within the past few years, and with far greater aggregate loss, perhaps, to the producers of it than is threatened to the producers of silver. People allow their imaginations to run away with them in respect to the precious metals. If the entire value of the world's supply of both gold and silver were wiped out in a moment, it might involve some temporary inconvenience, but no serious loss. It is nominally less than 2% of the world's wealth, according to Mulhall, and really not over 1%; and the richer countries have the least percentage of it, as a rule. Wiping out the entire value of all the silver in the world, therefore, means only a small loss, but there is no apparent danger that more than half of this value will disappear, if only the metal be left like tin and copper, to take care of itself.

The preceding hypothetical explanation of the fall of silver is not offered as a finality, but simply as an hypothesis which will sufficiently and reasonably account for the recent fall of silver if the main proposition be established: that the purchasing power of gold itself has been decreasing rather than increasing in recent years, which we now proceed to consider.

Taking the world as a whole, or any nation as a whole, the bargains for stated sums in dollars or other unit may be divided into two great and nearly equal classes: (A) Sales of material products, mostly necessaries and luxuries of life consumed within the year, and (B) sales of labor and service. These latter sales are either directly to others for cash, in the form of wages, salaries or fees, or (what is the same thing in effect) a man sells his own labor to himself at his own valuation, instead of selling it to others at their valuation, believing he can make more out of it under his own management than by a sale of it to others, and generally with truth. If he finds he cannot, he soon gives up the attempt and sells his services to others, and the higher the ruling rates for such sales the more likely he is to do this, obviously. Therefore, such changes as take place in the sum paid in cash for labor and service are a true index of corresponding changes in the amount earned from their own services by men who sell their time to themselves, so to speak. They may get more, but never less (for any length of time), than if they had sold their time to others.

The class of sales (B), therefore, represents the entire earnings from labor and service of the whole community; and if to this a comparatively small sum for interest on investments be added, it represents the entire income of the community. Of the actual cash income of the community, apart from such implied income as the interest on farms and homes owned, fully four-fifths is thus derived from labor and service.

The class of sales (A) of material commodities cannot possibly exceed class (B) in total value by more than the income from investments, and is less than the total amount produced by the large amount which is invested in permanent improvements by its producer or retained in his possession without ever being put upon the market. It is true that all material products are apt to pass through many hands before being finally used, whereas labor and service is rarely sold but once; but for our present purpose—determination of price tendencies—these reduplicated transfers do not count.

In a general way, therefore, we may say that the total value (A) of material products sold tends to approximate equality with the total value (B) of labor and service sold, but that (A) is likely to be less than (B), rather than more.

Whether this be admitted as approximately true or not:

Let A = The total absolute value by a perfect unvarying standard of all material products bought and sold in a given period of time.

Let B = The total absolute value of labor and service bought and sold in the same time.

Let V = The absolute value or purchasing power of a given unit weight of gold; say, 23.22 grains, which we have elected to call a "dollar."

Then the price in "dollars" of all values bought and sold will be at all times, so long as the purchasing power of gold remains constant:

$$\frac{A}{V} + \frac{B}{V} = \frac{A + B}{V}.$$

Let, now, some change take place in the absolute value of gold; say that it appreciates to some value V^1, so that 23.22 grains of gold will purchase twice as much absolute value as before, we have, then: $V^1 = 2\,V$, and we have also for the new price in "dollars" of all values bought and sold:

$$\frac{A}{V^1} + \frac{B}{V^1} = \frac{A + B}{V^1} = \frac{A + B}{2\,V}.$$

In other words, the nominal price in "dollars" will be only half as great as before; BUT all values whatsoever which are bought and sold in "dollars" are and must be equally affected by a change in the real value of the nominal dollar. This is equally true whether we divide all things sold in dollars into the two great classes A and B, or whether we divide them into howsoever many classes symbolized by as many letters of the alphabet. In either case the total absolute value of all products will be represented by the sum

$$A + B + \ldots\ldots + Y + Z,$$

and the value in "dollars" of all these will be represented by the fraction

$$\frac{A + B + \ldots\ldots + Y + Z}{V}.$$

It is as certain as any truth in mathematics can be that any change in the nominal value of things bought and sold which is caused by a change in the absolute value of V (purchasing power of 23.22 grains of gold) will affect the prices of A and B and Y and Z exactly alike; and if it be found in fact that it does not do so—especially if it be found that prices of A and Z are going down while prices of B and Y are going up—it then becomes mathematically certain that whatever other cause may be changing prices a changing purchasing power of the unit of value is not the only cause thereof, nor the chief cause.

This may be illustrated historically. It is certain that from a remote age, but especially since the discovery of America, the supply of both gold and silver has been constantly increasing, and hence, presumably, their purchasing power or absolute value has been decreasing. If it has been, the fact will be revealed in a rising price for both materials and labor, and the following figures, showing the number of pounds of wheat and days of common labor in England which has been purchasable for 4s. (or sensibly $1), will show that such a common increase in the price of both has actually taken place:

	Days of common labor purchasable for 4s. or $1.	Pounds of wheat purchasable for 4s. or $1.
B. C. 600		430
A. D. 1		330
" 500		310
" 800		314
" 1400	43	307
" 1500	39	314
" 1600	34	250
" 1700	14	154
" 1800	5	75
" 1850	3	37
" 1889	2	34

The above figures (with many others showing the same tendencies needless to quote) are given in Mulhall's Dictionary of Statistics.

It will be seen that since 1400 wages have risen 21½-fold, while wheat has risen 9-fold. Similarly, since 1600 wages have risen 17-fold, while wheat has only risen 7-fold. This indicates with certainty that, in addition to the change in the purchasing power of money which has affected both alike, some cause has been at work to lower the price of commodities faster than the price of labor.

One well known cause for this effect, which no one denies has been an important one, is the decreased cost of production, resulting from improvements in the arts. In the last half-century such improvements have been particularly and phenomenally great. Let us see how such improvements in the arts, if they were the only cause acting to change prices, would be likely to affect them.

Let I = The total income of any number of bread-winners, from 1 to 10,000,000.

Let A = The absolute value of the material products which they produce, which is sensibly the amount consumed.

Let B = The absolute value of compensation for labor and service which they divide up among themselves, in excess of the cost of products consumed, whether in the form of wages, salaries, fees, or profit from management.

Then, obviously,

$$I = A + B.$$

The standard value being assumed constant, as above stated, the above symbols may be taken either to represent absolute values or values in dollars.

Let, now, such progress in the arts take place that the total mass of products which makes the value A is only half as difficult to produce as before. Its absolute value will then necessarily be only half as great as before, or ½ A. The public might, therefore, if it pleased, produce twice as much as before, but inasmuch as all history shows that a nation does not, in fact, produce each year more than it needs for that year (or only a fraction more), and as there are good reasons why it should not, this great increase of production does not, in fact, take place, but the profits from the cheaper production are left available for division in the form of compensation for service. In other words, our equation takes the form:

$$I = \tfrac{1}{2}\,A + (B + \tfrac{1}{2}\,A),$$

in which the quantity $B + \frac{1}{2}\,A$ is in effect a new and larger value of B, the compensation for labor and service.

In regard to the distribution of this fund, naturally the managers of industry would like to keep it all for themselves; i. e., they would like to keep wages unchanged and put all the profits from improved processes in their own pockets. But they have not the power to do this, and to a large extent they recognize that it would be inequitable and do not attempt it. The recent history of silver mining in the West conspicuously illustrates this latter fact. Unskilled laborers have been demanding and receiving from silver miners two or three times as much as was paid for such work by others, or as they are now receiving.

We reach, therefore, the law that when prices of material products are falling because of cheaper production only, the unit of value retaining the same mean purchasing power, the fall in prices of commodities will and must be accompanied by a corresponding rise in wages or profits, or both. One will and must go up when the other goes down; whereas, when the change in price occurs from a change in the standard of value, or pecuniary yardstick, both will rise or both fall concurrently—a sharp distinction which ought to save any one from mental confusion.

It is a simple and necessary corollary from the preceding that when both kinds of changes are going on concurrently (as no doubt both always are in some degree) the following conditions will obtain:

With great progress in the arts and an appreciating standard of value:

Wages and business profits will tend to rise slowly and prices to fall much more rapidly.

With great progress in the arts and a stationary standard of value:

Wages and business profits will tend to rise and prices to fall by about equal amounts.

With great progress in the arts and a depreciating standard of value:

Wages and business profits will tend to rise very rapidly and prices to fall more slowly.

And so on for other conditions which are not those of to-day.

What are the facts? We have no space left to summarize them; but it is a well known and easily proved fact that in the past 20 to 40 years the market rates for labor and service have risen in almost exact ratio with the mean fall in price of all material products. Business profits (which are only another form of payment for service) have risen still more rapidly. Wages and business profits together (and they should be taken together) have undoubtedly risen somewhat more than prices have fallen, indicating that gold has been for the past 40 years, as for the past 400, decreasing in mean purchasing power rather than increasing. A report on wages and prices by the Senate Committee on Finance, made after an exhaustive examination by a special committee of distinguished senators (if any can now be called so), showed that the wage-earner of to-day not only receives higher wages in "dollars" in every branch of industry than in the past, but also that he can purchase vastly more of the necessaries of life than ever before, because of the concurrent fall in prices. According to that report the rate of wages increased in this country from 1860 to 1864 over 25%, and from 1864 to 1890 over 60%. The monthly earnings of laborers in manufactories in 1860 (the period of bimetallism) was $24.08; in 1864 (in inflated paper money), $30.24; and in 1890 (in gold), $38.69, showing a very marked increase as compared with three decades ago. Any table of prices will show that this ratio of rise is rather greater than the mean ratio of fall in the prices of commodities. Under these circumstances the mean purchasing value of gold must have decreased, if anything, in recent years. That there should have been any considerable or even any sensible increase in its absolute value is a mathematical impossibility, as we have endeavored to show. If we may infer the future from the past, there is not likely to be any.

LETTERS TO THE EDITOR.

A QUESTION OF ETHICS.

Sir: I observe in a late issue of your journal the following advertisement:

SEVENTY-FIVE DOLLARS given for position as Principal Assistant or Head Draftsman at a salary of $1,800 per year. Further particulars, address * * * care Engineering News.

I feel that all engineers take pride in the standing of their calling, whether they consider it a profession or simply a trade. And while many do not believe in a written code of ethics, every one must wish to see the spirit of honesty and fair dealing in his fellows, and to have this good reputation firmly established.

This is the practical code, and must exist before any written form of it can be of service.

In the slow work of building up standards of what is right and proper, the engineering journal should have a great influence. But little is accomplished by long editorials arguing for reform, if the business management at the same time inserts advertisements that are decidedly "quacky."

These applications for situations are a very practical index of the esprit du corps in the profession, and the paper should exercise discretion in publishing them, teaching those who do not know what is proper by sending back the advertisements to be rewritten.

It is well known that many political appointments must be paid for, but it is to be hoped that this form of bribery is not to become a recognized factor in securing engineering situations. Certainly no valuable man, who can earn a salary, is going to cast the suspicion on himself that he cannot get a place on his own merits, but must resort to some form of wire-pulling. This is a little matter, but it has caused a good deal of comment and criticism. P. L. C.

(This journal, like all other serial publications of any standing, is supported chiefly by its receipts from its advertising columns. Neither this nor any other journal attempts to set up a standard of good manners or good taste for its advertisers. The advertising space of this and all other periodicals is for sale at stated rates to any one who wants it to print anything he likes thereon, on the sole condition that it is not immoral nor indecent nor an attack upon individuals.

Our correspondent apparently objects to this advertisement because he thinks it is immoral in its purpose; a distinctly offered bribe. In forming this opinion he is at least premature, and we believe, unfair. Such may or may not have been the purpose in the mind of the author, and such might or might not be the result. If he expected that any one having a position directly in his gift would bite at such a bait, the advertiser would show himself even more fool than knave; for apart from all moral considerations, it is to the last degree improbable that any superior would put himself so hopelessly in the power of a subordinate as he would be forever after if he accepted such an offer.

It is much more probable, however, and certainly more charitable to assume, that the purpose in the mind of the writer was not to tempt some person who could himself give the position, but rather to induce the numerous outsiders who might know of an actual or approaching vacancy to interest themselves in giving him early notice thereof, and perhaps to put in a word to have the position held open in his behalf until he could present his own claims. Or he may well have hoped that this offer might be accepted by the employer himself as the equivalent of a two-weeks probation without pay.

In this there is nothing immoral nor even unbecoming on the part of the advertiser. It may or may not have been unwise. As to that issue, as we cannot assume to judge infallibly, we never attempt to judge at all. Neither is there anything necessarily immoral or unfair in a third party's accepting such a compensation for a service. Agencies exist for rendering precisely such services which are supported by just such payments as this, which, as only amounting to two weeks' pay, is not beyond a reasonable compensation for such a great service in these hard times, if any one felt he had earned it and chose to accept it.

When the action of another is susceptible of two interpretations, one honorable and the other dishonorable, is it not the universally recognized duty of indifferent outsiders to give him the benefit of a doubt in their judgment? Why, then, should a publishing company set up a harder rule of judgment to its own financial detriment?

Even had we believed, which we do not believe, that the underlying purpose of the advertiser was to suborn some man or men to abuse a trust, we still should not have felt bound to refuse this advertisement, for two reasons: First, because it is susceptible of a more honorable interpretation, and it is not for us to judge, as aforesaid; and secondly, because if there were some evil tendency among engineers which was making them susceptible to bribes, the greatest aid which we could give toward abolishing such practices would be to make their existence clear and conspicuous.—Ed.)

A LOGARITHMIC CHART.

Sir: Noticing in your issue of 28th ult. an article by Prof. W. F. Durand on the use of logarithmic cross-section paper, I herewith mail you a mathematical chart, which (though based on Günter's scale) is, I believe, novel, and, as it has a scale of over 52 ft. in length, is at the least 50 times as accurate as any cross-section paper I have seen.

Respectfully, C. W. Goodchild.

San Luis Obispo, Cal., Oct. 7, 1893.

(The chart sent by our correspondent is about the size of double sheet letter paper, containing a large number of parallel lines marked with a logarithmic scale, as he states; i. e., it gives any logarithmic value to scale. It is so arranged as to minimize the labor of determining any product or quotient from the sum or difference of these values, and is really an ingenious, accurate and, to us, novel device for obtaining in effect a slide rule some 52 ft. long from a single sheet of paper about as large as a page of this journal. It can be obtained from its author at a small price, and mounted on a board should be highly useful to those with much computing to do which requires more accuracy than the slide rule gives but less than absolute exactitude.—Ed.)

THE THEORY OF THE LUNGSTROM PLANIMETER.

Sir: In response to Mr. Johnson's letter in your issue of Sept. 28 I will say that the planimeter described in your issue of Sept. 14 has been known to me since 1888. Its origin is credited to a Danish mathematician, whose name I do not recollect. Mr. A. Lindstedt, Professor of Mathematics, Tekniska Hogskolan, Stockholm, examined the theory of this instrument and found, if I remember rightly, that the instrument is incorrect theoretically when areas of certain form are to be measured. Practically, however, the error is not so great as to affect seriously the usefulness of the instrument.

Any mathematical discussion to prove this would, I am afraid, be too long to interest your readers. I will, however, state briefly the theory of the Ljungstrom planimeter. If we move a wheel along a straight line, XX', Fig. 1, a certain distance, x, the reading on the wheel will be

$$R = x \cos v \qquad (I.)$$

if the plane of the wheel forms an angle, v, with the line XX', and the wheel is allowed free play, as supposed in a planimeter.

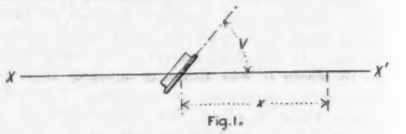


Fig. 1.

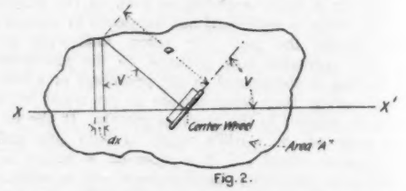


Fig. 2.

Hence assuming that the center wheel of the Ljungstrom planimeter, during the operation for measuring area A, Fig. 2, will travel along the line XX', and that the distance from the center of the planimeter to the point marked on the glass disk equals a, we have:

$$\text{area } A = \int a \cos v \, dx, \qquad (II.)$$

v being the changeable angle between the center wheel and the line XX', Fig. 2.

As a is constant, we have:

$$A = a \int \cos v \, dx;$$

and, in view of equation (I.)

$$\int \cos v \, dx = R, \qquad (III.)$$

R being the reading on the center wheel. Hence

$$A = a R. \qquad (IV.)$$

Or, if the division of the scale is based on a as a unit,

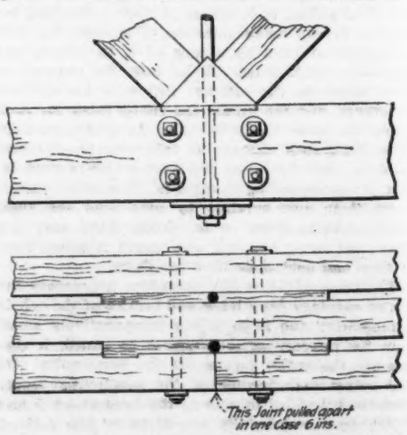
$$A = R.$$

Very truly yours,

Chicago, Oct. 2, 1893. Eric Swensson.

DEFECTIVE HOWE TRUSS BRIDGE CONSTRUCTION.

Sir: I recently examined several Howe truss bridges on a Southern railway, in which the bottom chord splices were made about as shown in the accompanying sketch. The splice was invariably made at a panel point, and the packing pieces, which formed the splice, were almost entirely cut away by the truss rods. These packing strips, about 1½ ins. thick, were



let into the chord from ¼ in. to ⅝ in.; but as the strip was cut nearly in halves by the rods, I presume this was merely the result of some vague recollection of work done on some previous span. There were two bolts each side of the splice, and these bolts must have done all of the transferring of strain across the cut by increasing the strain in the other chord pieces. One of the spans failed in three of four months; and a second pulled apart about 6 ins. at the joints and was carried on trestle bents.

A third span recently collapsed entirely under a train, with a loss of several lives. These bridges were built, I understand, by an "engineer" of considerable repute in the South. But I am inclined to believe that practically, as in the case of the Chester bridge, his connection with the work ended with the completion of the stress sheet, and that the work was from that time in the hands of the bridge carpenter, who considered that if he screwed up the rods until they were at the point of breaking, he had done his whole duty. After standing up for about four years to the risk of every train that crossed, the bridges were renewed. The timber was as sound as when the spans were built and the employment of a competent engineer would have saved thousands of dollars in renewals and in trestling up failing spans, and would probably have saved the lives lost in the recent wreck, of which, I think, the chord splice was undoubtedly the cause.

Respectfully, C. H. Wright.

Edge Moor, Del., Oct. 26, 1893.

DEVICE FOR RECORDING BRIDGE DEFLECTIONS.

Sir: I was much interested in reading of Mr. Thomas' device for recording bridge deflections, which appeared in your issue of Oct. 12. That Mr. Thomas' device is defective in not giving the paper a horizontal movement is quite evident, as you suggest. Several years ago I conceived a device for recording the most desirable diagrams of deflections, vibrations and other related phenomena. I send you herewith a pamphlet published by me two years ago, and from it you will see that it conforms in all respects to that which you indicate in the article named. This device originated with me several years ago; and I have not been able to learn since then that any similar device was in use prior to my conception of it. I infer in three several ways that I am the original inventor of just such a device as you indicate in the article referred to, but, for all that, the honor may be due to some one else. The credit for inventing so valuable a device justly attaches to some individual, and, among others, I should be glad to learn who is the rightful person. Would you therefore kindly inform me, or aid me in determining, when, where and by whom the first device for accurately recording bridge deflections was used, and much oblige Yours very truly,

Philip Noonan?

Palestine, Tex., Oct. 20, 1893.

(The pamphlet referred to contains the following brief description of Mr. Noonan's device.—Ed).

Attach a small iron rod to the base of one of the rails of an elevated track, and allow it to extend down nearly to the street. By fixing a lead pencil across the lower end of the rod you have an improvised arrangement for recording wave motion in the rails. The lower end of the rod, however, should be kept from oscillating, but free to act vertically, as the rails will cause the rod to rise up and down when trains are passing overhead. By guiding a card across the point of the suspended pencil, when trains are not passing, a straight mark will be made on it. By again guiding the card across the pencil point when a train is passing overhead, instead of the former straight mark, a wave line will be drawn. The straight mark on the card indicates the normal position of the rail, while the wave line shows the waves of depression and the swells in the rail resulting from wheels rolling over it, as will be readily understood.

Sir: In your issue of Oct. 26 Mr. C. B. Smith inquires concerning a recognized standard for rate of increase of load in testing cement. I refrain from giving your correspondent a word-picture of the scornful look a certain engineer gave me some years ago on expressing the opinion that "rate of increase of load" is a very essential element in testing cement. From Mr. C. B. Smith's tests it is at once obvious that considerable variation of results are obtained where ordinary machines are used, and I have frequently suggested that this variation might be more or less mitigated by using, for hand machines, a similar gearing and indicator to the large automatic testing machines or some similarly designed register. There is a good deal of difference between applying force with your fist and a steady pull, which about illustrates the personal equation in individual cement testing. Of what comparative use, then, is cement testing as at present conducted?

A cement specification should specify the amount and method of applying the strain, and this has been suggested by Mr. H. Faija in his recent paper, basing his opinion upon actual experiments and tests on Portland cement, and we should have similar information for American cements, which are so extensively used here.

In a series of recent tests with Louisville cement I applied the load at the rate of 90 lbs. per minute, which gave results surprisingly uniform in tensile strength from samples of same shipment; hence I feel sure similar results can be obtained and an improved cement secured by enforcing a standard determined by a competent committee, preferably of members of the American Society of Civil Engineers and manufacturers.

The amount of water used for mixing briquettes has an appreciable effect on some cements, and should be more definitely determined, say, with reference to the chemical analyses of each brand. The testing of cement neat should be a mere side issue in comparison to the necessity of testing, under the conditions in which it will be employed; therefore to "local sand" tests should be added Am. Soc. C. E. standard sand tests for comparison with recorded data.

The paper of Mr. Feret, abstracted by you in the issue above referred to, is in line of a decided advance on the proportions of cement mortar. Our "clean, sharp sand" practice of specifying is too indefinite and requires revision. I would ask if Mr. Feret's assertion that fine sand requires twice as much cement as coarse sand is not to be taken with a grain of "sodium chloride." It seems at first sight that the total volume of interstices to be filled is much greater with the coarser than the finer sand, in which case more cement would be required with coarse than fine sand. I understand that per unit of tensile strength the coarse sand is better. Yours truly, R. A. C.

Philadelphia, Nov. 1, 1893.

RATE OF APPLYING LOAD IN CEMENT TESTING.

Sir: In your issue of Oct. 26, p. 336, you say that you do not know of any treatise giving recognized standard rate of applying load in testing cement. In that connection see Baker's "Masonry Construction," p. 63, foot note. Yours, Ira O. Baker.

Champaign, Ill., Oct. 30, 1893.

(Our apologies are due to Professor Baker for overlooking the fact that his excellent treatise recommends the regular increase of load from zero at the rate of 400 lbs. per minute. He also quotes from Mr. Faija a table, showing the effect of variation in the rate of applying the load. The range of the table is from 100 lbs. applied in 120 seconds to the same load applied in 1 second, with respective limiting tensile records of 400 lbs. and 493 lbs. This record is the reverse of the experience of our correspondent of Oct. 26.—Ed.)

IMPORTANT TO APPLICANTS FOR SITUATIONS.

Sir: In your issue of Feb. 2, under the head of "Help Wanted," was an advertisement offering situations to several instrumentmen, transitmen, levelers and a topographer, requesting applicants to call on L. Christian Raub, Room 57, No. 53 Liberty St., New York City.

Being in search of work, I went some distance to see this man, I found the office locked, with a card on the door saying, "call at Room" stating the number. In reply to my inquiry here, a gentleman told me, rather testily, that this man Raub was out of town, in western New York, he thought, that he had never had an office in the building, that he had been there a few times only, to see a certain gentleman, who was also absent, and that he himself knew nothing at all of the man. Also that at least 40 men had called on the same errand as myself in the last few days.

Could you look into this matter, and find what manner of man this is who asks men to call on him and then skips out? I am respectfully yours,

E. W. Hess.

Hazleton, Pa., Nov. 6, 1893.

(On receiving our correspondent's letter, and personal complaints from others who had a similar experience, we sent a representative of this journal to the address named, and he was unable to obtain any more definite information with reference to the advertiser than that given in the above letter. Why a man should spend money in advertising for help, and then take no means to meet those who respond, is a puzzle which we cannot attempt to solve. We take this opportunity, however, to warn our readers that we cannot vouch for the responsibility or genuineness of those who insert cards in our want columns, as in many cases they are total strangers to us, their cards are usually sent in by mail, and it would be impossible for our business department to investigate their responsibility before publishing their advertisement.—Ed.)

NOTES AND QUERIES.

Mr. R. D., of Brooklyn, N. Y., asks for the present address of George H. Johnson, D. Sc., author of "Drainage Tables."

C. C. S., of Rockford, Ill., asks to be put into correspondence with parties supplying current water wheels of about 8 HP. A horizontal wheel is desired.

ECCENTRIC LOADING OF CAST IRON COLUMNS.

By F. Von Emperger, C. E.

In designing cast iron columns the fact of eccentric loading is seldom duly considered, though every load applied through brackets must necessarily belong to this class of loads. While tests of equally loaded columns abound, the writer is not aware of any series of tests of loads applied to a column through brackets. Mr. Christie, however, in his paper in the Transactions of the Am. Soc. C. E., 1884, mentions the fact that the smallest deviation from equal loading rapidly decreases the amount of the breaking load.

Where uniform safety is an object the eccentric loading of columns in exterior walls and corners must be taken into account; and the following figures show how materially these conditions change the loading effect: In Fig. 1 we will call the centrally applied load, transmitted from the upper stories through the upper column P_1; and the floor load from the girder, P_2, applied on the bracket at a distance "p" from the center of the column. It is quite usual to give the lower column a section A, if

$$S = \frac{P_1 + P_2}{A} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The S is taken from Gordon's, or a similar formula, all based upon the central application of the load.

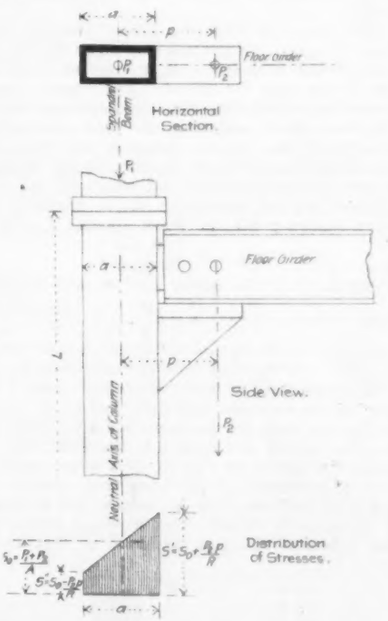


Fig. 1.

A little consideration will show this to be incorrect for the case assumed here. The load P_2, eccentrically applied does not only press down, but also tends to bend the column, with a force increasing with the distance "p." The bending moment is $M = P_2\,p$; consequently the stresses will be unequally distributed. Fig. 1 shows this distribution graphically, and the stresses in the outer fibers are given by the equation:

$$S = \frac{P_1 + P_2}{A} + \frac{P_2\,p}{R} \quad \ldots\ldots\ldots\ldots (2)$$

R is the moment of resistance of the column section.

$$R = \frac{I}{e} = \frac{2\,A\,x^2}{a};$$

in which "e" is the distance of the outer fiber from the neutral axis, in this case $\frac{a}{2}$, and x is the radius of gyration.

If we now compare for an equal factor of safety an interior and an exterior column, with the same length and smallest diameter and using the same value for S, we will have in equations 1 and 2, and even for the same load, a different value for A. The difference will be greater as the load P_2, the eccentricity "p," or the distance "e," increases; or as the moment of inertia I decreases.

In some cases known to the writer the section adopted for the outer columns would have to be increased four times to give them the same factor of safety for the same load applied to the inner columns. But as this method of calculation would involve a great waste of material, owing to the fact that the outside fiber only takes the stress S, the writer proposes to show how this waste can be avoided.

Before doing so, however, attention will be called to an example that can be seen any day by those using the Sixth Ave. elevated railway in this city, and shown by a photographic reproduction. Fig.

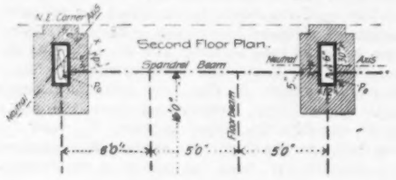


Fig. 2.

2 is approximately correct only, as it is intended merely to show how weak the columns could be made and yet conform to our building laws. That they are really stronger than the law demands is to the credit of the designer and not due to the law itself.

The case is an interesting one of eccentric loading. The cast iron columns stop under the second floor, having on their tops an inverted shoe, and on top of this shoe rest eccentric and massive brick pillars; while both floor beams and spandrel beams are also placed eccentrically. This eccentricity is about 5 ins. for the spandrels and about 17 ins. for the floor beams on the second floor. Taking a very modest figure for a trial calculation, we will suppose that the eccentricity of the resultant P_o of all loads is p = 6 ins. From equation 2 we find

$$S\,A = P_0 \pm \frac{P_0\,p\,a}{2\,x^2}.$$

Substituting in the above: a = 30 ins.; $x^2 = 90$; and p = 6 ins., we have $A = 2\frac{P_o}{S}$.

In other words, the section should be just twice as great as if the load were centrally applied.

The eccentricity of wall loads is not confined to cases of the class just described. Led on by a desire to save wall, and the prescribed 6-in. fireproofing, the position of a column in the front wall is usually as shown in Fig. 3. This means an increased eccentricity on the inner side. Details of this kind, and especially at corners, can be seen in the majority of our recent buildings with cast iron columns. The plea advanced is that they

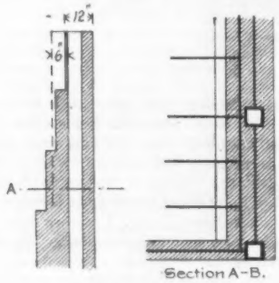


Fig. 3. Position of Columns in Front Wall.

are stronger than necessary anyhow, and, unfortunately, the designer is fully justified by the building laws as they are now framed. In the opinion of the writer, this seeming disregard of eccentricity in loading, together with the use of a small factor of safety is, as Mr. Milliken also says in Engineering News of May 5, 1892, the cause of the failure of the corner columns there referred to.

There are two ways in which the waste of material may be avoided in applying eccentric loads; both are intended to bring the neutral axis and the point of load pressure nearer together. The first is shown in Fig. 4, but is not always applicable. It is a cast iron column with an open section, so shaped that the load from the side rests upon a central support. The second method (Fig. 5) is one of casting with the metal so distributed that in cases of small eccentricity, as given above, it is possible to reduce "p" to zero, and thus use the same section A, with the same factor of safety for inside and outside columns. But as both of these methods involve special forms and some trouble, their value does not seem to be properly appreciated in practice, and it cannot be expected to be done as long as the building law does not prescribe it.

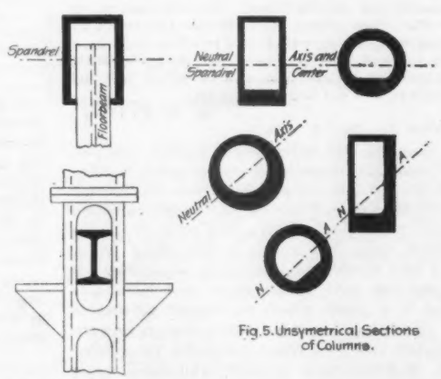


Fig. 4. Interior Console.

Fig. 5. Unsymetrical Sections of Columns.

WEIGHTS AND MEASURES OF THE UNITED STATES.

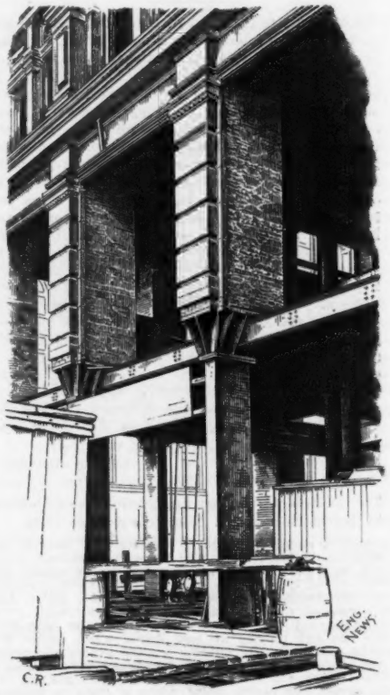
The development of a standard system of weights and measures in the United States is discussed by Prof. T. C. Mendenhall, Superintendent of the U. S. Coast and Geodetic Survey, in a paper presented at the recent International Engineering Congress, at Chicago, and also in a recent number of the "Technology Quarterly." He says, in brief, that though the Constitution of the United States gave Congress power to establish a system of weights and measures and to fix standards, there was no legislation upon the subject until 1828. Previous to this date, however, the executive departments of the government were compelled to establish some standards of length, mass and capacity to govern the collection of customs and taxes. To Mr. Hassler, the first superintendent of the Coast Survey, was confided the task of providing and fixing these standards, and from that time to the present this officer and his successors have also been the Superintendents of Weights and Measures. Mr. Hassler, early in the century, brought from Europe a brass bar, part of which was for many years the unit of length used by the executive departments.

But owing to the irregular practice in the several states and to the fact that in many of them the units of length and mass were only traditional and without legal value, Congress on May 19, 1828, passed the first and almost the only definite act of Congress upon the subject of weights and measures in current use. That act provided that a certain piece of brass, now known as the Mint Troy Pound, should constitute the standard for regulating the coinage of the United States. This standard, judged according to modern ideas, is exceedingly irregular and imperfect in form and construction, though it was doubtless a very precise copy of the British standard troy pound then in use and destroyed a few years later in the burning of the Parliament House.

In June, 1836, Congress provided that a full set of the standards of weights and measures used by the Treasury Department in the customs service should be delivered to the Governor of each state in the Union, and this was done within the next few years with the effect of for the first time securing uniformity in the customary weights and measures. The primary units of these standards were the yard and the pound. The first was taken from a certain distance marked on the Troughton brass bar brought over by Hassler in 1813, and was practically the English yard. There is not and never has been any legislation fixing the temperature at which this standard is to be accepted. For a long time the standard temperature was assumed to be 62° Fahr., though at this temperature it was longer than the present Imperial standard. This rate was, therefore, afterward altered to 59.6°, at which temperature it accurately agrees with the present Imperial standard, though they have only been compared with each other by copies.

The standard of mass sent out to the states was the avoirdupois pound as derived from the mint pound referred to, which was a copy of the British Troy pound of 1758. As the present British avoirdupois pound is derived from the same standard, it is safe to say that there is little outstanding difference between them, and the practice of the Office of Weights and Measures is to assume them as identical.

The measures of capacity adopted originally by the Treasury Department were the wine gallon and the Winchester bushel, both of which are theoretically derived from the old standard of length. The wine gallon contained 231 cu. ins. and the Winchester bushel 2,150.42 cu. ins. These, however, are old colonial standards, and differ con-



A Case of Eccentric Loading in a Recent New York Building.

siderably from the present English standards of similar names.

The metric system of measures was first recognized in the United States by the important act of Congress of July 28, 1866, authorizing and making lawful the use of the metric system in this country. In the same act a set of tables was adopted establishing in terms of United States weights and measures the equivalents in terms of the metric system. About the same time the Secretary of the Treasury was authorized to distribute to each state and to land grant colleges a set of metric standards.

It was later discovered that the copies of the metric standards in use in various parts of the world did not agree perfectly with each other, and their relation to the original or prototype meter was not known in a manner satisfactory to the requirements of modern science. In fact the original meter was defective according to the modern methods of testing and constructing standards. The result of this doubt was the establishment near Paris of a permanent International Bureau of Weights and Measures, supported by contributions from nearly all civilized governments of the world and controlled by representatives of these govern-

ments. After 15 years of labor and research this bureau, in 1890, successfully completed a considerable number of copies of the original Meter of the Archives and of the original or prototype kilogram. These were all compared with the original standards and with each other with the highest degree of precision attainable and their differences, while small, were known with a great degree of accuracy. The meter and kilogram agreeing most nearly with those of the Archives were selected as the great international prototypes of length and mass, and the other copies were distributed by lot to the contributing nations. The United States obtained possession of two standard meters, Nos. 21 and 27, and two standard kilograms, numbered 4 and 20. These were officially received on Jan. 2, 1890, by President Harrison and Secretary of State Blaine, and Secretary of the Treasury Windom, and by their certificate attesting to their identity and condition they became the national prototypes for the United States.

As no action has ever been taken by Congress defining a yard or a pound, the act of 1866 legalizing the metric system makes the latter the only system of weights and measures ever made lawful by act of Congress, and in this the mint pound of 1828 is not excepted, as it was only made lawful for purposes of coinage. Basing its action upon this existing condition of affairs, the Office of Weights and Measures feels justified in accepting the metric prototype standards now in the possession of the government as the only lawful standards, and the superintendent has lately announced that hereafter the yard will be defined as a certain part of a meter and the pound shall be a certain part of the standard kilogram. This action will not interfere in the slightest degree with the practical or commercial use of the yard or the pound, though there are very important theoretical and scientific advantages in thus referring these units to the international standards which are already recognized by the greater portion of the civilized world. These definitions, according to the act of Congress of 1866, were as follows: One yard equals $\frac{3600}{3937}$ meter; one pound equals $\frac{1}{2.2046}$ kilogram.

WORLD'S PRODUCTION OF PRECIOUS METALS, 1849-1892.

The accompanying diagram is, up to 1889 inclusive, a literal reproduction of one included in the report on "Gold and Silver," compiled by Mr. William Kent, for the U. S. Geological Survey, and published in the official "Mineral Resources of the United States" for 1889-90. To make the diagram more interesting, complete and significant, we have extended it up to the end of 1892 by official figures given in "Universal Bimetallism" by Mr. R. P. Rothwell, editor of the "Engineering and Mining Journal," which annually compiles very complete and early statistics as to mineral products, as most of our readers know.

While the diagram is not as carefully reduced to an average of all authorities after 1889 as it is before, the values are for all practical purposes quite as useful and accurate. Absolute accuracy, is, of course, unattainable for any year.

As respects the status prior to 1849, when the diagram begins: The production of the precious metals in the 358 years 1493-1850 inclusive is estimated at about $3,240,000,000 gold and $6,950,000,000 silver, a yearly average of some $9,040,000 gold and $19,400,000 silver. The enormous output from Mexico and Peru began in 1520-30. During the first 100 years after this began (i. e., up to 1620) the ratio of gold values to silver rose slightly and slowly from 10.75 to 12.25. In the next 60 years (to 1680) it rose to 15.00 and thereafter fluctuated fractionally only for 190 years to 15.57 in 1870, when the steady decline in price began which has continued with some fluctuations to the present day.

The estimated relative stock of silver and gold in 1850 stood about 2 to 1 in coinage values. Since then the enormous gold outputs of California and Australia have so increased the stock of gold that at the present time the world's stock of the two metals is about equal in value, the stock of gold having increased about 2½ times, while silver has (up to 1890) only increased some 30%, according to Mulhall. Nearly 90% of the output of precious metals since 1492 has come from the New World. The store existing at that date (in European countries at least) was insignificant, some $165,000,000 only, or only about 1½% of the world's present supply.

The price of silver in London in pence per ounce since 1849 is plotted on the top of the accompanying diagram. Mr. William Kent says in regard to this price:

> The table (diagram) does not reveal the cause of the decline in the price of silver; for if it be assumed that the ratio of the production of silver to that of gold controls the price of the former, then the decrease in the price should have begun in 1860, when the ratio of silver product began to increase, and the decrease would have been more pronounced in 1867, when the silver product increased more rapidly and the gold production decreased. There is nothing in the figures or in the diagram to explain why the decline began in 1873 instead of in 1860 or 1867. A study of Soetbeer's figures for 380 years, from 1493 to 1873, will also show no relation between the relative production and the relative price of gold and silver, and from 1800 to 1870, although the value of the product of the two metals varied from 3.227 silver to 1 of gold down to 0.44 silver to 1 of gold, the relative price varied only between 15.41 and 15.83 to 1. From the year 1873 to the present time, however, there appears to be a very close agreement between the product ratio and the price ratio, as shown by the coincidence between the columns in the table representing "gold production, per cent. of total gold and silver," and price of silver in pence in London. Thus, in 1873, the total value of the gold product, expressed as a percentage of the total of the gold and silver, was 59.9%, and in 1889 it was 43%; the price of silver in London in 1873 was 59¼d., and in 1889 42¾d.

The opinion with which this quotation opens seem to us somewhat doubtful; for in view of the remarkable constancy in the silver ratio for nearly three centuries, it was perfectly natural that the increased production of recent years should not begin to affect prices until it had continued for some time; in other words, until it had become an unmistakable evidence of a permanent and increasing tendency, and not of a mere temporary fluctuation. That it is such, the diagram certainly gives strong evidence.

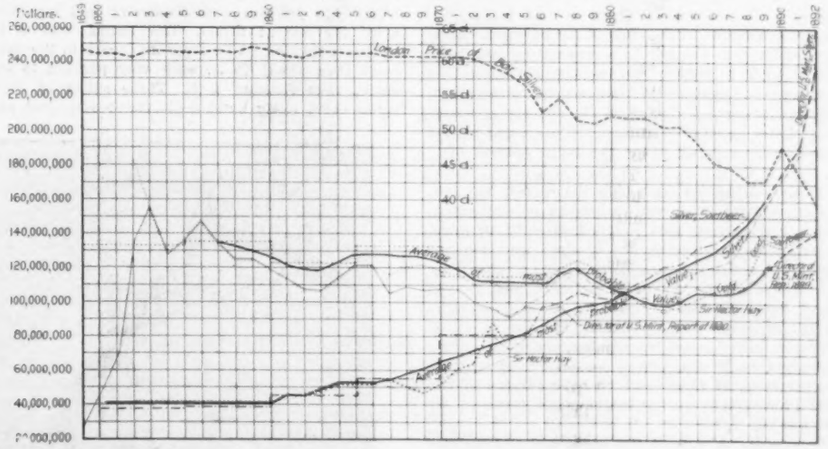
Still, the fact remains that the recent change in relative production of silver and gold does not approach in magnitude nor duration that which followed the conquests of Mexico and Peru, which yet did not affect the value ratio of silver to gold very materially, nor practically affect it at all after the first 80 years, ending with 1680.

On the other hand, bearing in mind the more rapid pace of the 19th century, what took place early in the 17th century was not so very different in nature from what is going on to-day, though it was much less in degree and much slower. In the whole of the 16th century the silver ratio fell only from 10.75 to 11.80, or less than 10%; but in the succeeding 80 years, 1600-1680 (during which the silver output was falling off slightly), it fell from 11.80 to 15.00, a decrease of 27%. In the 22 years 1870-1892, it has fallen from 15.57 to 23.73, a decrease of somewhat over 52%.

Two probable explanations of such contrast as exists suggest themselves. In the first place, until the 19th century the world was not statistical; and the vast moral effect of a general knowledge of aggregates and tendencies was therefore lacking. It was natural, therefore, that prices should respond to supply and demand far more slowly than they do now.

The second, and we believe the leading cause was that the supply of both gold and silver was very scanty when the supply from America began to come in, and as the precious metals were practically the only currency, a large supply of either was readily absorbed. At present, the world's supply of gold alone is very large, and neither gold nor silver is used as currency by the civilized nations except for petty cash expenditures and for settling balances, 90 to 95% of the world's exchanges being effected by paper representatives of value. It is stated by Mr. Mulhall that the bank checks cashed every month in London and New York alone largely exceed in value all the gold and silver coin in existence.

Under these circumstances it seems to us that a leading cause for the exceptionally rapid fall of silver in late years may be that the world finds it has enough of gold alone for all the purposes for which it still uses metallic currency, and hence that even the existing supply of silver is becoming mere surplusage. This view is supported by the little appreciated facts which are summarized on another page, which show that the average purchasing power of gold has certainly not increased, but rather decreased, in the past 30 or 50 years if measured by the only fair standard, the average price of all things bought and sold, including labor and service as well as material commodities.



WORLD'S PRODUCTION OF GOLD AND SILVER, 1849–1892, ACCORDING TO DIFFERENT AUTHORITIES, WITH LONDON PRICE OF BAR SILVER.

(Compiled up to 1889 by William Kent for U. S. Geological Survey; extended to end of 1892 from data given in "Universal Bimetallism" by R. P. Rothwell. Silver is given at coining value.)

THE SALTAIR BEACH BATHING RESORT.

By W. P. Hardesty.

The large bathing resort recently completed at Saltair Beach, on Great Salt Lake, Utah, about 12 miles west of Salt Lake City, presents some novel features in its construction. Owing to the shallowness of the water, it was necessary to locate the buildings some 4,000 ft. from the shore, to which they are connected by a pile bridge over which trains run, landing passengers directly at the pavilion.

The whole structure rests on 2,500, 10-in. cedar piles driven 8 ft. into the bottom of the lake. In driving these piles a somewhat novel method had to be resorted to. The bottom consists generally of about 18 ins. of sand, under which is a bed of crystallized sulphate of soda, varying from 3 ft. to 10 ft. in thickness. A hole had to be made in this deposit for each pile by means of a steam jet, the salt being dissolved by forcing the nozzle down and working it about. A few minutes sufficed to reach the required depth. The pile was then placed in position, sometimes given a few taps with the hammer to settle, and in from 12 to 24 hours the soda had solidified and the sand packed so that the pile was perfectly tight.

The resort consists of the great pavilion, built

after the Moorish style of architecture, with curved wings reaching out on either side and containing the bathrooms. The accompanying cut (Fig. 1) gives a very good view of the whole structure. The total length of the building is 1,114 ft. and the total width 335 ft.

The lunchroom occupies the first floor of the pavilion, and is 143 ft. 4 ins. × 251 ft. 4 ins. The dancing hall occupies the second floor, and is 118

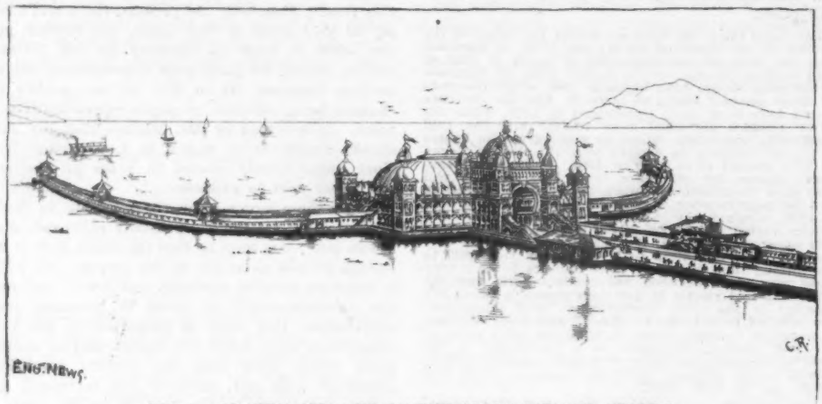


FIG. 1. GENERAL VIEW OF SALTAIR BEACH BATHING RESORT.

ft. 8 ins. × 251 ft. in the clear, with a wide aisle or passage all around, and will easily accommodate 1,000 couples.

The roof of the dancing hall is supported by trussed arches, as shown in Figs. 2 and 3. There are twelve main arches, spaced 12 ft. apart and having a span of 118 ft. 8 ins. The halves of these arches have a simple pin connection at the top, while the bottoms are connected by pins to trestle supports directly under the dancing floor. Tie-rods leading across under the floor connect the bottoms of the arches. There are 24 half-arches in the half-circles at the ends of the pavilion. They are fastened at the top to a crescent-shaped, horizontal arch at either end of the skylights, the bracing being continuous from one end to the other. The arches have a rise of 56 ft., and are crescent-shaped (on account of taking up less room at the ends), with a depth along the main portion of 7 ft.

The steel trestles by which the arches are supported extend from top to bottom of the lunchroom, and rest on sills founded directly on piles. The arches and trestles are of steel, and are calculated to resist the maximum strains produced by the action of the following weights and forces: Dead load, 20 lbs. per sq. ft. of roof surface; weight of people on the walk, 80 lbs. per sq. ft. of walk; weight of snow from 20 lbs. per sq. ft. on the haunches, to 30 lbs. per sq. ft. on the crown; resultant force at right angles to the surface of the roof produced by a horizontal wind force of 40 lbs. per sq. ft.

The height to top of the main tower from the water is 130 ft. The bathhouses are 620 in number, situated 9 ft. above water, and are furnished with an ample supply of fresh water, pumped from artesian wells situated on the shore. The entire resort is lighted by electricity, the company owning its own plant. There are 1,250 incandescent 16-c. p. lamps and 40 arc lamps.

The structure was built by Salt Lake capital and workmen, work being begun Feb. 1 and completed June 1 of the present year. The cost was $200,000. Mr. R. Kletting, of Salt Lake City, was the architect of the entire structure. The ironwork was done by the Lane Bridge & Iron Works, of Chicago, Ill., W. H. Roney, Chief Engineer.

THE PORT CRESCENT TOWNSITE AND BREAKWATER.

Engineering works involving the outlay of large capital are often carried out by townsite companies in the West and South. An undertaking of this sort at Crescent Bay, Clallam Co., Wash., involving the laying out of a town, with some street building, and the construction of two breakwaters, was described in a paper read before the Canadian Society of Civil Engineers, on Oct. 26, by Mr. A. S. Going. Some of the interesting points in the paper have been abstracted as follows:

In January, 1890, the Port Crescent Improvement Co. was incorporated, to build a townsite on Crescent Bay, the nearest point on the American shore to Vancouver Island. This bay is a part of the Straits of Juan de Fuca, which have a general width of 12 to 16 miles and are 40 miles east of the Pacific Ocean. A townsite of 400 acres was immediately laid out, some roads and buildings and a wharf constructed, after which the harbor was surveyed, soundings taken, two breakwaters located and the construction of one, some 3,500 ft. in length, begun. This breakwater was designed to be a rock-fill, 25 ft. wide on top, with slopes of 1½ to 1, an average height of 50 ft., giving an average sectional area of 5,000 sq. ft.

In August, 1890, a tunnel, or mine, was started from the end of the proposed breakwater into the rock cliff, for the purpose of throwing some material into position and displacing and loosening more for use in filling. The tunnel was 4 ft. square, extended 78 ft. from its face into the solid rock, then about 45 ft. each way parallel to the shore, thus forming a T. Three shifts of eight hours each, using hand drills, were employed and the average cost of the work was $6 per lin. ft. On account of a seam in the rock at the top of the hill above the tunnel it was feared that the blast might blow out at the back. To obviate this, springing holes were drilled in the face of the cliff on each side of the mouth of the tunnel. The tunnel was loaded with 18,000 lbs. of black and Judson No. 2 powder and was fired Sept. 28, 1890, by means of an electric battery 1,200 ft. away. A rough measurement showed that about 15,000 cu. yds. of rock had been displaced and at least 10,000 cu. yds. loosened. Some of the rock was thrown as far as 150 ft. from the shore, in the line of the breakwater. Tracks were next laid, and by means of push cars with a capacity of 1½ cu. yds. each, the structure was carried out 100 ft. from the shore. From this point on the track was laid in advance of the filling, on 12×12-in. stringers resting on pile bents 15 ft. apart, each consisting of four piles 9 ft. apart, capped with 12×12-in. timbers and sway-braced. No ties were used. The track was narrow gage, double, with 40-lb. rails. The cars could be dumped from either the side or end.

In November, 1891, the financial depression on the Pacific Coast made necessary the suspension of the work, after the filling had been carried out about 300 ft. and the piling, 405 ft. The storms of the succeeding winter carried away all the unfilled piling and changed the slope of the rock filling, leaving it 1 to 1 for 20 ft. from the top, then curved to about 2 to 1. Eventually the slopes will have to be filled to 1½ to 1 on the east and 2 to 1 on the west side, the heavy swells, which the breakwater was built to cut off from the harbor, coming from this side. During the surveys the velocity of the current between the headland and the reef to which the breakwater is designed to extend, was found to be about four miles per hour.

SMALL ARMS IN 1883 AND 1893.

The change in small arms for the use of the armies and navies of the world is almost as radical as is that in ordnance. Ten years ago the great nations of the world were using breech-loading rifles, but with calibers ranging from 0.42 to 0.6 in., soft lead bullets and ordinary black powder. To-day, Italy, Roumania and Holland have adopted a caliber of 0.256 in., and experiments are being made with a 5 mm., or 0.197-in. caliber. All service rifles lately adopted by foreign powers use smokeless powder, and the cartridges are fed from a box magazine temporarily attached to the gun.

The use of soft lead for bullets has almost entirely disappeared. Hard lead is now used for the core, and this is enveloped in nickel-copper, sheet steel, or in a nickel-copper alloy. The wounds made by these small caliber bullets are peculiar, though this action has not yet been thoroughly tested in a great war. According to late experiments, these bullets act like shells at a short range, the steel envelope often breaking off and tearing a jagged path of its own. At a range of 1,000 yds. they make clean holes through the breastbone and pass through the thigh bone without shattering it.

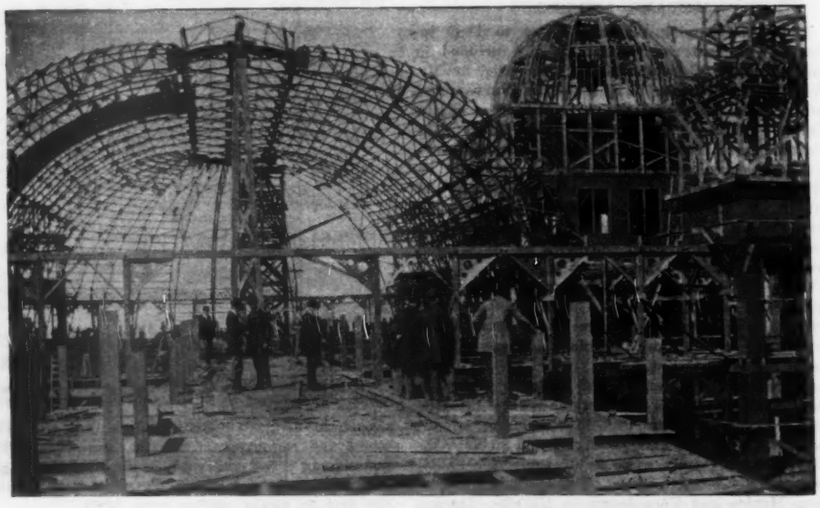


FIG. 2. VIEW SHOWING IRONWORK FOR ROOF OF MAIN DANCING HALL.

While the range has increased from 1,200 yds. to 2,850 yds. in the last ten years, the penetration is likewise largely argumented. Late English authorities give the penetration of the modern small caliber bullet as follows, at 440 yds.: In steel, 5-16 in.; in iron, ⅝ in.; in pebbly gravel, 10 ins.; in brickwork, 8 ins.; in sand in sacks, 28 ins.; and in oak, 21 ins. In 1883 the weight of the rifle, without

bayonet, ranged from 9 to 11½ lbs., while at the present time the average weight is a little under 9 lbs.

IRON AND STEEL WIRE.

The following is an abstract of a paper lately read before the British Iron and Steel Institute by Mr. John Phillips Bedson, Assoc. M. Inst. C. E.:

The full subject of the paper was the development of the manufacture of iron and steel wire. Wire beaten from gold plates was known to the Hebrews and referred to in Exodus XXXIX. 3, and specimens found in Egypt date to 1700 B. C. In a history of Augsburg, of 1351, and in Nuremburg chronicles of 1360, wire made by the "draw-plate" is referred to as used contemporaneously with the more ancient method. The writer is inclined to the belief that iron-drawing originated in Germany and then extended to France about the end of the 15th century. It is stated that wire was made by hand in England until 1565, when Christopher Shultz, a Saxon, came to that country under a permit granted by Queen Elizabeth, and introduced the draw-plate.

The Forest of Dean, which supplied good charcoal iron, was long the seat of the wire-drawing trade, the iron being first "tilted," or hammered into ¼-in. square rods, 3 to 4 lbs. in weight, and then drawn into a circular form of the required size. The Tintern Abbey Wire Works were first started in 1575 by four German families working with very crude appliances, and the total output of the works, even in much later time, was about 26 cwts. per week. Mr. G. Bucknall Smith, in his work on "Wire: Its Manufacture and Use," says the first mechanical wire mill proper in England was erected in 1663, at Sheen, near Richmond, Surrey, and from the meager data available he judges that the revolving block was in use.

So little progress was made for many years in the mechanical appliances for wire-drawing that at the beginning of the present century the father of Mr. Bedson, then a highly skilled Birmingham wire-drawer, drew down by the old methods a piece of bar steel, 1 in. in diameter and 9 ins. long, to a wire as fine as a human hair with the purpose of exhibiting it to George IV. on his visit to Birmingham. This bar was first forged to ¼ in. round and then passed through a drawplate and annealed until it assumed the required fineness.

The first departure from old methods, at an uncertain date, was the introduction of the vertically revolving block which wound the wire about it as it passed from the drawplate; and the next step was the application of power, usually water power, to this revolving block. Wire was first drawn from square strips cut from plates, until Corts' invention enabled round rods to be rolled, and even then these could only be produced of 12 to 14 lbs. in weight.

The Cooke & Wheatstone patent for an electric telegraph, of June 12, 1837, eventually created a great demand for wire and for long wire, and Mr. George Bedson, of Manchester, drew wire from 30-lb. rods. Mr. Bedson made the wire for the Dover-Calais cable of 1851, and also for the first Atlantic cable of 1857. In 1860 he invented a continuous galvanizing process for telegraph and fencing wire, and in 1862 he patented his continuous rod-rolling mill, in which a 1 1-16-in.

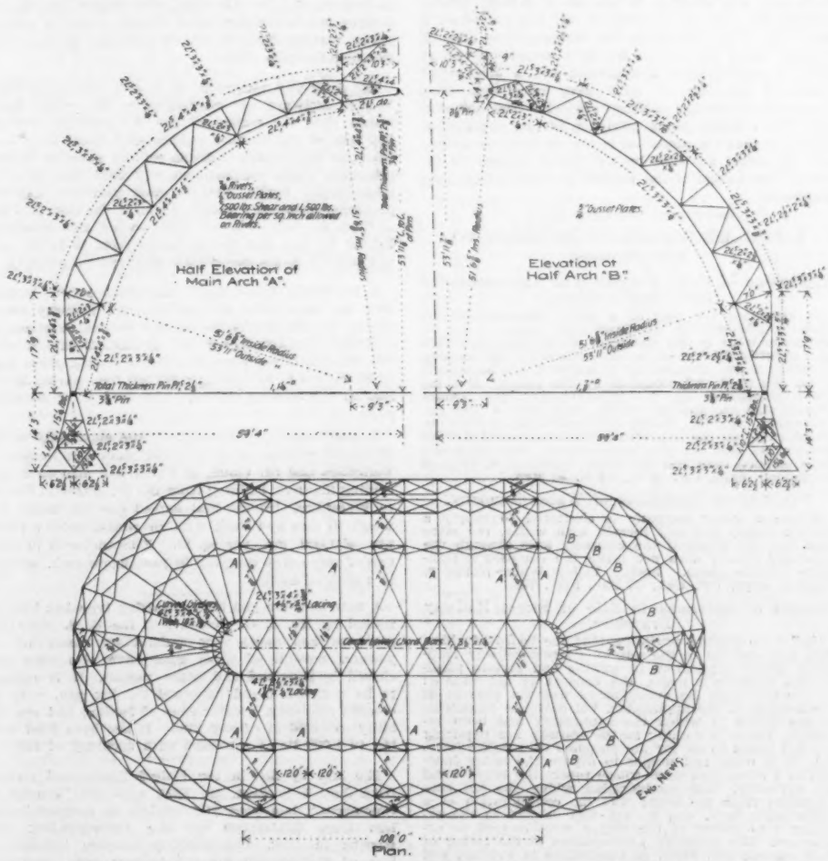


FIG. 3. ELEVATION AND PLAN OF IRONWORK FOR MAIN DANCING HALL.

square billet, weighing about 100 lbs., passed from a Siemens gas furnace directly to the first roll of the mill, and then on successively through 16 pairs of rolls. It was a difficult machine to perfect, but finally had a capacity of 20 tons in 10 hours. This device, however, would not roll common iron wire rod, and its production was confined to telegraph wire and the best qualities of fencing wire. All iron for this wire was box-piled, with four square puddled billets in the center and four flats outside, of either Best Best puddled iron, or top and bottom of charcoal with sides of Best Best, or charcoal all around. This wire was known in the telegraph trade as B. B., E. B. B., or four-sided charcoal wire, and from some one of these three grades came the bulk of the telegraph wire used all over the world. Its great merits were the great length of single pieces and its uniformity of quality.

In 1870 Bessemer metal made a change in the wire trade, and it gradually replaced iron where simply mechanical results were required. The use of Bessemer metal grew to very large proportions until 1884, when it received a rude check from the introduction of the basic Bessemer under the patents of Thomas and Gilchrist. This new system again revolutionized the wire trade, for it enabled wire to be made from poor ores and the highest cold blast metal, only approached in quality by the highest class of Swedish charcoal Bessemer.

Mr. Bedson says wire-drawing was introduced into the United States in 1666, and until some time between 1830 and 1860 there was no material advance. One of the first improvements was made at the Fall River Iron Works, in 1839. In 1869, Mr. Ichabod Washburn, of Worcester, Mass., erected a Bedson continuous wire rod rolling mill; this mill was enormously developed, however, by Messrs. C. H. Morgan and F. H. Daniels, both of Worcester, Mass. Mills designed by these gentlemen on the continuous system have been constructed to turn out from 2,000 to 2,500 tons of wire rods per week. Mr. Wm. Garrett, of Joliet, Ill., has also perfected a rod mill and can turn out 150 tons of No. 4 wire in 10 hours, from rods weighing 150 lbs. each. His automatic reel winds up the rod immediately that it is rolled and thus prevents all slack and the snarls that would otherwise both spoil material and stop progress. The present rod-rolling capacity of the United States, worked at full speed, is estimated at 1,000,000 gross tons per annum.

Barb wire was first made in 1873, at De Kalb, Ill., by Mr. J. F. Glidden, and the yearly product has grown from 5 tons in 1874, to 200,000 tons at the present time. Wire nails, a thing of the last ten years in the United States, now aggregate 200,000 tons per year. The author estimates the wire rod capacity of England at 100,000 to 120,000 tons per annum for all grades.

BRIDGE RENEWALS IN INDIA.

We learn from "Indian Engineering" that iron bridge renewals on quite an unprecedented scale have been found to be necessary on the Bombay, Baroda & Central India Ry., a line having only some 460 miles of line, but running northward along the coast from Bombay through a region which calls for much bridging. No less than 700 spans of a mean length of 60 ft. each require renewal or strengthening, and are alleged to be in a highly dangerous state. Our contemporary explains the situation and also discusses the proper method of remedying it in the following article; taking the occasion to enforce certain truths which sometimes need enforcement in this country as well as India.

The renewal of practically the whole of the bridges of a system, some 700 spans of 60 ft., is a question of sufficient interest, both in an engineering and financial point of view, to challenge attention beyond the immediate neighborhood of the railway concerned.

It does not appear, so far as is generally known, that either the officers of the company or the government inspecting officer have quite done their duty in neglecting renewals of this magnitude until the bridges are in absolutely a dangerous state, for we understand that several tiebars have cracked at the pinholes and been removed from these bridges. Everybody in India except those concerned appears to have realized the bad condition of these girders, as several of them had been utilized in lines up-country and looked upon with great suspicion.

The significance of the fact that some of the members have begun to fail should not be overlooked. The history of a structure that is strained beyond the load it will permanently bear is that a certain, or perhaps it would be more correct to say an uncertain, number of repetitions of the load will destroy it. This breaking down appears to have begun on the B., B. & C. I. bridges, and as it is probable that they are all much about the same strength and fit, and certainly carry the same number of loads, when they once begin to go they will all fail together.

The present state of affairs appears to be that it is proposed as an experiment to strengthen 50 spans according to a scheme distinguished as Plan A, proposed by the chief engineer and improved upon by Sir A. Rendel as consulting engineer to the company. Plan A appears to be a scheme of trussing, on the merits of which it is difficult to pronounce in the absence of drawings, but the matter may fairly be discussed on general grounds.

Plan B appears to be really building a new girder between the parts of the old one, and having gone so far, we should think it best to scrap the old girders altogether and put in new plate girders.

To revert to plan A, the objection to any device of trussing old girders, the metal of which has been already overstrained, is the impossibility of assigning to each part of the structure any definite proportion of the load. Modern researches have developed the theory of elastic structures so that it is possible within narrow limits to ascertain the strains in structures with redundant members, but it is obvious that no method can touch the solution of strains in a structure the initial strain in the members of which is unknown. It is, indeed, possible that the internal strains in such a structure might reach a dangerous amount without external load at all. No doubt the details proposed by Sir A. Rendel are the best possible under the circumstances and the prospect of saving about half the cost is attractive to the Board, but the warning against putting new wine into old bottles is one that we hold applies very instantly to this particular case. Nor are the results to be obtained from a "trial" of any practical value. Suppose 10 or 20 spans fitted up, how many years will it take before the effects of the loads will be apparent on the weak parts? How many years has it taken for the present girders, defective as they are, to break down? And what, in the mean time, will be done with the other 600 spans? We regret to see also that in all references to these, as well as to other trusses, "test" is held to mean "deflection." The pernicious idea that a deflection test gives any information whatever as to the capacity of a truss for its work is one that we have often combatted, and will seize this and every occasion to assault it again until defunct.

Only the other day a bridge in Hungary was "tested" in the most successful manner with perfectly normal deflections until it suddenly collapsed from a faulty end connection. We remember on the occasion of Lord Mayo's funeral, a bridge in Calcutta, the strength of which was doubtful, was "tested" with some artillery wagons and successfully carried the funeral cortege. But it fell down shortly afterward without any provocation. Such instances could be multiplied ad nauseam, yet the Board of Trade and the Indian government, and even engineers who ought to know better, "test" bridges both new and old and gravely report upon their suitability from their deflections. These very Baroda bridges were duly "tested" in their youth and found satisfactory, yet they have worn out. In fact, there would be nothing abnormal about their deflections even now, so far as the causes of their breakdown are concerned. What result, then, is it supposed will be attained by "testing" them again or making a "trial" of any addition?

Suppose two similar trusses, the one with members of uniform and ample strength but weak joints, or one weak place, such as faulty compression member or flawed tie; and another with all members and joints of uniform but insufficient strength. The deflections of the former would be perfectly normal as if the truss were altogether sufficient, but it might be absolutely dangerous; while the other would give an excessive deflection with comparative safety.

Our readers must pardon this insistence on facts that should be and are probably perfectly well known, but they are certainly not applied—even with all the science at the disposal of the State Railway Department. There is another absurdity connected with this "testing" business which shows that the people concerned act without the slightest thought. We read of the Blank Bridge being tested with n of the heaviest engines, put buffers together so as to produce the greatest strain, and the deflection was only so much. Why this intense desire to get the heaviest load? Is there any single fact connected with a metallic structure that cannot be known from the statement that a load of n tons produced a deflection of m inches, quite as well as from a record of 2n tons and 2m inches? We respectfully suggest for the consideration of the Director General of State Railways and the Board of Trade whether it would not be possible to teach a "heavy L" engine to waltz along on its hind legs like a dancing dog, so as to get a still greater load than it would produce in its natural position.

SPECIALIZED INSTRUCTION IN ENGINEERING SCHOOLS.

We abstract from a paper on "Present Favorable and Unfavorable Tendencies in Engineering Education," by Director Palmer C. Ricketts, of the Rensselaer Polytechnic Institute, the following remarks on the above much-disputed point, with the general spirit of which we fully sympathize. Granting that there is a demand for special training in particular departments of engineering, the question cannot but arise: Can a man meet much success in any particular department of engineering work without a pretty sound grasp upon the general principles underlying all its departments, and some little knowledge of the peculiarities of each of the main departments of each? and if not, is four years more than enough to give such knowledge?

Differences of opinion still exist upon it and customs vary greatly. To what extent optional studies should be allowed in such courses has been a mooted point. To what extent specialization should be permitted or encouraged in early training for professional life should likewise be carefully considered. Although the field of the engineer has become so broadened that specialists are required as in other professions, it is not considered wise to begin such differentiation at too early a period in the education of a young man. No one in practice can confine himself to one branch of professional work without continually making use of principles found in the others. Not only should the education in the schools not be too special, but the engineer who has had a certain amount of practice in various branches of the profession is more likely to become eminent as a specialist than one whose theoretical and practical education has been confined within narrow limits.

Does a person who intends to become an oculist or a patent lawyer take a different medical or law course from one who intends to become a general practitioner? In order to become in the highest sense a specialist in the design of the superstructure only of bridges, must not a man be, to a certain extent at least, a metallurgical, a hydraulic and a mechanical engineer? Certainly he must have more than even a general knowledge of these subjects. The difficulty with the average young graduate of our engineering schools is that his education is too narrow, too technical. It should at least be left broad enough to include a knowledge of the various branches of his own profession.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Application of Front Foot Rule in Assessment for Local Improvements.

In assessing the cost of a street improvement on abutting property by the front foot, regard must be had as to what is the real front of the property. This is a question of fact to be determined by the manner in which it was laid out, or in which it has been built upon, and used and occupied, by the owner. If a lot abuts lengthwise on the improvement, but fronts breadthwise on another street, and not on the improvement, the lot should be considered as fronting breadthwise on the improvement, and assessed for the number of feet on the improvement that it would have in such case and no more. Haviland v. City of Columbus. Supr. Crt. of O., 34 N. E. Rep.

Taxation on Franchises of Water Company.

Where a water company is chartered to supply a certain county and city therein with water, the mere fact that the pipes of the company pass through the adjoining county does not make the company's franchise taxable there. Spring Valley Water-Works v. Barber. Supr. Crt. Cal., 33 Pac. Rep., 735.

Consent of Aldermen in Sale of Street Railway Franchise.

Under the statute providing that the board of aldermen may consent to the sale of a street railway franchise where application in writing and certain publications have been made, the consent is not vitiated by the fact that the entire board was not present at the hearing on the application, but only the committee of the board to which the application had been referred. There is nothing in the railway act requiring the full board to sit for the purposes of a public hearing. It is usual and proper to depute the latter function to a committee upon whose report the board could act advisedly. The consideration which the act contemplates from the board was the consideration of a deliberative body, and its act was subject to the ordinary veto power of the mayor with respect to ordinances. The statutory prerequisites to the giving of such consent are: First, an application in writing; and second, before acting upon such application, the publications provided for. Power to give the consent, upon proper circumstances, then becomes complete, and the board can thereafter exercise the power upon such consideration as it deems suitable and sufficient. There is less force in the objection that the resolution of the board should be published pursuant to the consolidation act. That provision is inapplicable to the consent of the local authorities required by the constitution and the law. This consent is in no just or legal sense an alienation or appropriation of the property of the city, and the objection on that head proceeds upon a misconception of the precise nature of the power of the board, and of its action under the power. The section in question plainly refers to property owned by the city, and within its power of disposition. Here the city has the fee of the street, but such fee is in trust for street uses by the people of the state. The city cannot alien its title to the streets nor dispose of its technical property therein. The franchise proceeds from the state, and the consent of the local authorities is simply a form of street use. The only limitation upon the power to fix further conditions is that such conditions shall not contravene the statute, nor relate to matters over which other bodies have complete control. This is another way of saying that the conditions must be reasonable and lawful. The board has a right to give or to withhold its consent. It can lawfully say that it will give its consent to a road to be operated in a particular manner. It is not an attempt to exercise power as to the motor. It simply leaves the applicant to procure, as best it may, the means called for by the condition. So as to the condition requiring the deposit of $1,000,000, subject to draft, for the construction of the railway. The court cannot condemn this condition as unreasonable. On the contrary, it is a prudent requirement to insure the activity in the construction of the road, and to prevent sham bids in the interest of those who may be inimical to the extension. The criticism upon the form of the resolution in this particular is somewhat superficial. The condition does not in reality require the completion of the road before the expiration of the statutory period of three years. It merely provides that, if the road is not completed within two years, so much of the deposit as may then be unexpended shall be forfeited. It is but one way of requiring the expenditure of the entire deposit within two years; and, as the extension will cost at least $2,000,000, it is not unreasonable, in this manner, to compel the expenditure of one-half of that sum within two-thirds of the statutory period. Such is the real meaning and effect of the condition, and all that is contemplated. The only condition which calls for further consideration is that with regard to the division of the single fare. No definite opinion need be expressed on that head. Abraham v. Meyers (Comptroller), Sup. Crt. of N. Y., 22 N. Y. Supp., 225.

Gas engines are in very extensive use in Germany. A report by Mr. Frank H. Mason, Consul-General at Frankfort, states that in 1891 there were in operation throughout Germany about 18,000 gas motors, aggregating about 60,000 HP. There are probably 24,000 to 25,000 in use at the present time. The largest sizes of these motors are said to have reduced gas consumption to 17.6 cu. ft. per HP.-hour. One reason for the extensive use is the low price of gas, which is sold at prices varying from 95 cts. to $1.36 per M ft. in the principal German cities.

The petty and antiquated ideas still existing on some English railways are emphasied by the recent statements that the trains on the Metropolitan District Ry. (one of the London underground lines) have been equipped for electric lighting on the penny-in-the-slot principle. Each compartment will have four 20 c. p. incandescent lamps, two on each partition, and the passenger dropping a penny (2 cts.) in the slot gets one of these for half an hour. The cars are now miserably lighted by gas, and the managers seem to be too narrow minded to use the electric light system properly.

A ten-wheel, two-cylinder compound freight locomotive has been built for the Jamaica Railway (West Indies) by the Rogers Locomotive Co., of Paterson, N. J. It has cylinders 20 x 26 ins. and 29 x 26 ins.; driving wheels, 4 ft. 2 ins. diameter, with a driving wheel base of 12 ft. 3 ins., and weighs 137,500 lbs., having 97,000 lbs. on the driving wheels. The road is of standard gage.

A compressed air tramway, worked apparently on the Mekarski system, is to be built from the Louvre to Versailles and St. Cloud, in Paris, and also on a connecting line now building from the St. Augustin Church to Vincennes. On the first named line the motor will weigh 18 tons and work with air stored under a pressure of 1,000 lbs. per sq. in. This motor is to draw two of three cars carrying 50 passengers each, or more in a rush of traffic.

A new machine gun of the Gatling type has been invented by Mr. J. G. Accles, and the U. S. Navy Department has made very satisfactory tests of its powers. Several of these guns have also been purchased by England and other powers. It is claimed to be a modified and improved Gatling gun, with increased efficiency, greater ease of loading and less liability to accident of any kind. It has been fired from 800 to 1,000 times a minute with accuracy of aim.

The loss by fire in the United States and Canada from Jan. 1 to Sept. 30, 1893, says the "Journal of Commerce," has been $121,832,700, as compared with less than $95,000,000 for the corresponding nine months in 1892. The monthly average indicates a loss of $160,000,000 for the present year. Statistics gathered by the insurance companies show that in 10 states last year from 40 to 80%, and in nineteen other states from 20 to 40%, of the entire number of fires were of incendiary origin with intent to defraud the companies issuing the policies. As this practice is supposed to be growing. Fire Marshal Whitcomb, of Boston, suggests a more rigid inquiry into the antecedents of would-be insurers by adopting the "application blank" system of life companies. He believes that as a result about 75% of the policies lately issued in Boston would have been refused by the companies.

The "Campania" and "Lucania" are breaking Atlantic records at a confusingly rapid rate. On Nov. 3 the "Campania" completed the eastward passage in 5 d. 12 h. 10 m., allowing 4 h. 35 m. for the difference in time on the two sides of the Atlantic. On Nov. 4, the "Lucania" arrived at the Sandy Hook lightship, having made the western voyage in 5 d. 12 h. 54 m. She thus beats the best previous record for the western passage, made by the "Campania," Oct. 20, in 5 d. 13 h. 23 m. The 'Paris' westward record of

5 d. 14 h. 24 m., made a year ago, stood good until Oct. 6, 1893, when it was reduced by the "Lucania" to 5 d. 13 h. 45 m. Consequently, in less than one month the record has been reduced by over two hours.

It is reported that surveys are being made by the Winnipeg Canal & Water Power Co. for a canal to connect the Lake of the Woods with the Red River near Winnipeg, Man. It is said that the lake is 305 ft. above Winnipeg, and that the canal would be used to float logs.

The highest meteorological station in the world has just been established by Harvard University on the top of El Miste, a nearly extinct volcano of the Cordilleras, in Peru. The top of this sharp, detached peak is 19,200 ft. above sea level, or almost 3,500 ft. higher than the station of the French Academy on Mt. Blanc. Harvard has another station, established two years ago by Prof. S. G. Bailey and W. H. Pickering, part way up Mt. Chachani, at an altitude of 16,650 ft. above the sea. These two stations are about 10 miles apart, and the same distance from the Harvard astronomical station at Arequipa, Peru, now under the charge of Professor Bailey.

A shipment of large timbers was recently made from Tacoma, Wash., to Hamburg, Germany, for the use of the German Government in bridge building. The total shipment was 1,300 M ft., B. M., and comprised timbers varying from 16 × 16 ins. and 40 ft. long, to timbers 24 × 24 ins. × 124 ft. The 20 × 20 in. timbers ran from 60 ft. to 124 ft. in length, and the 22 × 22 in. and 24 × 24-in. timbers from 80 ft. to 124 ft. in length. There were 100 of the 24 × 24 in. × 100-ft. sticks, and a correspondent writes that often 50 ft. of the stick would be absolutely clear, without a knot or streak. Some of the 2-in. and 3-in. plank were 60 ins. in width.

Dining cars of a very elaborate character have been built by Brown, Marshall & Co., of England, for the Peninsular & Oriental Steamship Co., to run on the "overland route" between Calais (France) and Brindisi (Italy), approximately 1,200 miles, in connection with the company's steamers for India, etc., which touch at Brindisi for English mails and passengers. The cars are 61 ft. long and 9 ft. 2 ins. wide, with steel channel sills and steel and wooden framing. They are carried on four-wheel trucks, with steel frames, wooden bolsters and the Arbel wrought iron wheels with steel tires. The dining saloon has a capacity for 30 persons, having five tables for four persons each and five for two persons each. At one end is the kitchen, lined with asbestos and sheet iron, and at the other end is a smoking-room with seats for seven persons. The interior finish is in oak and teak. The cars have monitor roofs, end platforms and doors, with vestibules and side steps. They are lighted by gas and heated by hot water, and are fitted with electric annunciators. The cars are fitted with the Westinghouse, Smith-Hardy and automatic vacuum brakes, as all these are used on one or other of the numerous railways over which these cars have to run in making the through trip. Passengers and mails by this service leave London on Friday at 8:15 p. m.; Calais, 1 a. m. on Saturday, and reach Brindisi at 7:40 p. m. on Sunday, or about 48 hours from London, and leaving at 9 p. m. for India, etc., on the steamer which sailed from England on the Wednesday. This is by the steamship company's special trains of dining and sleeping cars.

The use of dry earth closets is practiced in some of the villages and cities of Ontario, and has been recommended in others, according to the last report of the Provincial Board of Health. Kingston, the population of which in 1891 was 24,260, has 288 dry earth closets. It is stated that these gave better satisfaction than in former years. The adoption of galvanized iron buckets is recommended, the wooden boxes and tubs being liable to become foul from soakage. The city has a sewerage system but its extent is not stated. At Woodstock 700 dry earth closets are in use. This town is said to be partially sewered. Its population in 1891 was 8,612. The local health boards of Deseronto, Southampton and Weston have recommended the use of dry earth closets.

The Panir Tunnel, on the Mushkaf-Bolan Ry., India (Eng. News, March 23 and April 20), is approaching completion, the headings having met on Aug. 21. The tunnel is for a double track of 5 ft. 6 ins. gage, and has a semi-circular arch of 29 ft. 6 ins. span, while the height is 22 ft. 3 ins. from subgrade, or 20 ft. 9 ins. above rail level. Its length is 3,050 ft. The Belgian system of construction was adopted, with a top heading 8 × 8 ft., enlarging for the arch, and ultimately underpinning the arch where necessary. The drills were 4-in. Climax drills, worked by natives, and in hard rock were preferred to the Schram drill, which was also tried. Two 1¼ to 1⅝-in. drills on one stretcher bar drilled 25 holes 4 ft. deep in the face of the heading in five hours, the machines making 300 strokes per minute under 60 lbs. pressure. The power plant consisted of four air compressors and four 24-HP. boilers, six to eight tons of coal dust per day being used as fuel. The air was carried 6,100 ft. and over an elevation of 1,000 ft. by 4½-in. pipes, with little leakage. The explosives used were dynamite and gelignite. Work was commenced by hand on Nov. 20, 1892, and the average progress was 13 ft. per day, the best month's progress being 455 ft. There are no shafts. The temperature in the headings was from 92° to 100°, which, with the dampness, was very trying. Outside, the temperature was from 104° at night to 117° by day in the shade. A correspondent writes that the tunnel is situated in the lower Bolan Pass, which is the hottest place in the world between May and September. The railway is on the northwest frontier, and will connect Quetta with the Punjab railway system. It leaves the plains about 400 ft. above sea level, and in 60 miles surmounts the summit of the Bolan Pass, an elevation of 6,000 ft. The steepest grade is 4%, compensated.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & OHIO.—This company has secured a loan of $3,000,000 on bonds of its subsidiary lines and will use the money in paying off floating obligations and to carry on its policy of extension into tributary territory.

NEW YORK & NEW ENGLAND.—Some further particulars regarding the extension of this railway into New York City have come to light since our note of last week, but they do not seem much more reliable than the first reports. As stated then, a contract, in form at least, has been made with the Ryan & Macdonald Construction Co., of Baltimore, Md., for the construction of the required new line, this company to furnish all the money necessary to build and equip the line. In regard to the New York City connection with the Manhattan Elevated Ry., Mr. George J. Gould is quoted as saying that to his knowledge no negotiations had taken place between the two companies. According to the press reports the connection with the elevated will be at a union station to be built at 3d Ave. and 149th St.

NEWPORT & SHERMAN'S VALLEY.—The Path Valley R. R. Co., whose incorporation was noted last week, will be an extension of this road. The Newport & Sherman's Valley line will be extended from Blaine, Pa., its present terminus, to New Germantown, Pa., 4 miles, and from New Germantown to Dry Run the line will be built by the Path Valley R. R. Co. Grading has been commenced both at New Germantown and Dry Run. Pres., David Gring, Newport, Pa.

Projects and Surveys.

BOSTON & NOVA SCOTIA COAL CO.—It is announced that the company has now finished its negotiations with the Provincial Government preliminary to the construction of its line from Orangedale, N. S., to the Broad Cove coal mines, and it is probable that construction will begin at once, as the contracts were let some time ago. The line will be 33 miles long. Ch. Engr., C. M. Odell, Neabou, N. S.

MARYLAND.—It is stated in press dispatches from Oakland, Md., that the construction of a line from Sang Run to Oakland, Md., is an assured fact, and in fact that contracts have already been let. Work is expected to begin about March 1, next.

LANCASTER, OXFORD & SOUTHERN.—President Walter M. Franklin is reported as saying that the road from Singerly's, Cecil Co., Md., to Quarryville, Pa., will be built soon.

Southwest—Existing Roads.

MONTGOMERY, TUSCALOOSA & MEMPHIS.—This company has entered into contract with the Mobile & Ohio R. R. Co. will guarantee $3,500,000 of bonds which are to be issued to complete the partly graded line from Montgomery to Tuscaloosa, Ala., and secure the further extension of the road to Columbus, Miss. It is stated that the contract for construction has been let to J. W. Woolfolk, 38 Wall St., New York City.

BALTIMORE & OHIO SOUTHWESTERN.—The Ohio & Mississippi Ry. Co. and the Baltimore & Ohio Southwestern R. R. Co. have completed their consolidation under the above name. The first board of directors is: Edward R. Bacon, William L. Bull, Edgar T. Wells, Edward R. Bell, W. Mertens and John H. Davis, New York; W. W. Peabody, Lowe Emerson, Fred. H. Alms and Briggs S. Cunningham, Cincinnati, O.; Frank W. Tracy, Springfield, Ill.; Julius S. Walsh, St. Louis, Mo.; James H. Wilson, Wilmington, Del., and John Haseltine and Patrick Buchan, London, Eng. Mr. Bacon will probably be elected president.

OHIO RIVER & CHARLESTON.—The two divisions of the Charleston, Cincinnati & Chicago R. R. which were completed in Tennessee and North Carolina some three years ago have ben consolidated under the above name, and it is stated that the short stretch of line required to connect them will be built. The company has been in financial difficulties for some time.

Northwest—Existing Roads.

ILLINOIS CENTRAL.—A report is in circulation that this company proposes to extend its line from Le Mars to Yankton, S. D. No very reliable information can be had, however.

Projects and Surveys.

MINNEAPOLIS, ST. PAUL & LAKE SUPERIOR.—The officers of this company announce that work will commence about Dec. 1 clearing the right of way for this line from St. Paul and Minneapolis to Superior, Wis., and that actual construction will begin early next spring. Grant Bros., of Faribault, Minn., have the contract for constructing the line, but will probably let it to subcontractors when work is begun. It will be 137 miles long. Ch. Engr., F. D. Woodbury, Minneapolis, Minn.

MISSISSIPPI & LEECH LAKE.—The city of Little Falls and Morrison Co., Minn., have voted $160,000 in aid of this proposed railway from Little Falls to St. Cloud, Minn., and it is stated that engineers will be placed in the field at once. The road is backed by the Weyerhauser lumber syndicate.

TERRE HAUTE, MT. VERNON & SAYLOR SPRINGS.—A dispatch from Terre Haute, Ind., says: "There is a new project for a railroad running southwest from Terre Haute with which the long-talked-of Terre Haute, Saylor Springs & Mount Vernon Co. may be consolidated. The new project is inspired by Olney citizens, who sent J. N. Boyer, agent of the Peoria, Decatur & Evansville road, to this city to consult with capitalists and railroad men. The Peoria, Decatur & Evansville having bought the Chicago & Ohio River road, the tracks of the latter for a considerable distance have been taken up and connection made with the Peoria, Decatur & Evansville from Olney. The scheme is to utilize the roadbed of the Chicago & Ohio, by which a considerable saving in construction would be made and the distance to Mount Vernon would be shorter than the older route. Mr. Boyer was assured that the offer of the Terre Haute people still stands, which is to build the road to Terre Haute when the Illinois people have built to the state line."

Southwest—Existing Roads.

TEXAS MIDLAND.—Engineers are reported to have begun the survey for a line from near Garret to Ennis, Tex., and local reports state that it will be built at once.

NEW ORLEANS & NORTHWESTERN.—Press dispatches announce that the contract has been let for the extension from Rayville, La., to Collins, La., 17½ miles, where a connection will be made with the Houston, Central Arkansas & Northern R. R., to Bagnell & Johnson. It is stated that surveys and grading were to have been begun last week.

MISSOURI, KANSAS & TEXAS.—Surveys have been begun for the proposed extension from San Marcos to San Antonio, Tex., 40 miles, and work is in progress securing the right of way and depot grounds. M. M. Fay is in charge of the surveys.

Projects and Surveys.

KANSAS CITY, ELDORADO & SOUTHERN.—The town of Nevada, Mo., has decided to raise the $15,000 bonus asked by Fremont Wilson in aid of a railway from that place to Eldorado, Mo., 23 miles. Eldorado has already raised a bonus of $12,000 in aid of the scheme, and it is stated that the $15,000 from Nevada will also undoubtedly be secured.

SAN ANTONIO & CAMPBELLTOWN.—It is stated that the citizens of Live Oak Co., Tex., have received a proposition from Eastern capitalists in which they promise to build a railway from San Antonio to Campbelltown, Tex., for a bonus of $150,000.

Rocky Mt. and Pacific—Existing Roads.

COLORADO MIDLAND.—It is announced that work has been begun in earnest on the Midland Terminal road from Cripple Creek to Divide and that it will be in operation within 30 days.

CANADIAN PACIFIC.—The Nelson, B. C., "Miner," says: "The Canadian Pacific Ry. corps of surveyors now engaged on the Crow's Nest line are making the most of the remainder of the season, which is growing short. One party is taking the levels and the other is running the line down the Moyea. Unless some change is made in the present program the road will come down the Moyea and cross on the divide between that stream and the head of Goat River, and come down the Kootenai on the south side of the Goat River. The railroad company has surveyed a new townsite on the divide between the Moyea and the Goat rivers. Work is progressing rapidly on the Revelstoke & Arrow Lake road. The objective point for the season's work is the Wigwam, a place about 15 miles below Revelstoke. This is the point where the ice usually jams first in the spring. The ice also forms early at this point. While this piece of line will not secure uninterrupted communication during the year, the chances are that the route can be kept open later in the year and resumed earlier than under the old system. Contractor McGillivray will crowd the work in order to facilitate matters on the Nakusp & Slocan. He hopes by this means to be able to get in a sufficient quantity of supplies to continue on to Three Forks without any cessation of work."

ATCHISON, TOPEKA & SANTA FE.—A survey is in progress for a railway line from Maxwell City, N. Mex., to Amizett and Taos, which is stated to be probably in the interest of this company. The distance to Taos is 80 miles and it is stated that a further extension to Santa Fe, N. Mex., is contemplated.

STREET RAILWAYS.

CLINTON, MASS.—The Clinton St. Ry. Co. will apply for a franchise to extend its line through Lancaster, Mass.

HAVERHILL, MASS.—A meeting of business men from Chester, Raymond, Hampstead, Plaistow, Derry and Salem, N. H., held a meeting at this place recently and pledged financial support to any electric railway scheme that would open up these towns. The plans, as far as developed, are for two lines of electric railroad from Haverhill. One is via Atkinson, Hampstead, Chester and Derry to Haverhill, and the other is via Ayer's Village, Salem, Windham and Hudson to Nashua. Haverhill capital is to be interested, and offers for stock have been made in every town. The first step to be taken is the organization of a corporation preparatory to seeking a franchise from the New Hampshire legislature. The scheme includes over 60 miles of electric road.

PASSAIC, N. J.—The Passaic & Newark Electric Ry. proposes extending its line to Newark.

ERIE, PA.—The contract for building the Edinboro & Erie St. Ry. has been let to the Sumens R. R. Building Co.

SCRANTON, PA.—The contract for building the extension of the street railway to Minooka has been let.

YOUNGSTOWN, O.—Two street railway companies are applicants for a franchise to construct a line from Youngstown to Lauterman's Falls. The city council has decided to grant a franchise, but receivers of it will be compelled to pay $15,000 toward a new bridge on South Market St. The company will be compelled to keep the bridge in repair, will be allowed a double track on the bridge as well as on South Market St., but will not be granted a loop around the square.

HIGHWAYS.

MASSACHUSETTS.—A state highway is to be built from Boston through Dedham, Norwood, Walpole, Wenham and Attleboro to the Rhode Island boundary. Several of the towns have made appropriations for the surveys.

WYOMING.—Merchants in Fort Collins are agitating for a new road from that city to North Park.

UofM

CALIFORNIA.—Surveys for a new road to Box Springs, in San Bernardino county, are being made by C. Pierson, Co. Surv., of Riverside, Cal.

WATER-WORKS.

CONCORD, N. H.—Rights in Long Pond have been bought for a future additional supply, which it is said will be by gravity through about nine miles of mains.

HAVERHILL, N. H.—Surveys for works have been made by Joel Foster, Montpelier, Vt.

MARLBORO, MASS.—Bonds to the amount of $30,000 have been authorized for improvements, probably those noted last week.

WORCESTER, MASS.—Mains are to be laid in a number of streets.

BARRE, VT.—It is reported that a company has been organized to supply a portion of Websterville and that a reservoir is under construction. S. D. Allen and Chas. Churchhill are interested.

HARRISON, N. Y.—The Harrison Park Water & Supply Co. has been incorporated; $10,000.

CONNEAUTVILLE, PA.—Works are proposed.

LACEYVILLE, PA.—The Citizens' Water Co. has been incorporated; $5,000; Treas., Bradley W. Edwards.

LURAY, VA.—Works are projected; estimated cost, $27,000.

PETERSBURG, VA.—The council has voted $12,000 for land for a storage reservoir site and for the protection of the watershed.

SHELLMON, GA.—It is reported that the city will build works, including a water tower.

CADIZ, O.—The people have voted, 539 to 69, for works to cost $35,000.

MT. STERLING, KY.—A franchise has been granted to parties represented by J. M. Pickrell, of this place. Work must be started by Dec. 25, 1893, and be completed within a year. The sum of $3,520 per year will be paid for hydrant rental.

WARRENSBURG, MO.—The 20-years franchise granted by the council to J. H. Christopher has been ratified at the polls.

HOWELL, MICH.—A contract for works has been let for $33,000.

BERLIN, WIS.—It is reported that the council will advertise for bids for works.

NEENAH, WIS.—A contract for main extension has been awarded to W. G. Maxey, of this place.

SIDNEY, WASH.—It is reported that $5,000 of bonds have been voted "to purchase a water plant."

SPOKANE, WASH.—Bids are wanted by the city until Nov. 17 for a dam, races and other accessories, power house, turbines, pumps and conduit. Frank Ritzer, Clk. Bd. Pub. Wks.

SPOKANE, WASH.—The Lidgerwood Park Water Works Co. has been incorporated; $45,000.

LUNENBURG, N. S.—It is said that a company will begin to lay mains for works at once.

BRACEBRIDGE, ONT.—The people have voted $25,000 for water and light plants.

TORONTO, ONT.—Cy. Engr. E. H. Keating has recommended that an intake tunnel be built under the bay to North Island, 5,500 ft., and an intake pipe extended across the island and into the lake. The various other schemes for a new supply during the last few months are not approved.

ARTESIAN WELLS.

CAMPBELLTOWN, N. B.—Wells have been started for a fire protection supply.

IRRIGATION.

COCORIT, SONORA, MEX.—Bids for constructing 20 miles of canal are wanted by the Sonora & Sinaloa Irrigation Co., 58 William St., New York City, as stated in our advertising columns. Col. E. S. Nettleton, Chf. Engr.

NEW COMPANIES.—Spring Creek Ditch Co., Narrows, Ore.; $300,000. Clear Lake Land & Irrigation Co., Salt Lake City, Utah; $300,000; Pres., C. W. Aldrach; Secy. and Treas., Walter Brown.

SEWERS.

CAPE ELIZABETH, ME.—The selectmen have awarded a contract to H. H. Pittie for 2,000 ft. of sewers in South Portland, and 1,350 in Cape Elizabeth.

BENNINGTON, VT.—The cost of the 8 miles of sewer is estimated at $28,000.

BROCKTON, MASS.—An appropriation of $10,000 for laying sewers has been recommended by the sewerage commissioners.

NEW BEDFORD, MASS.—The cost of the Davis St. sewer is estimated by Mr. Drake, Supt. of Sewers, at $13,000.

WORCESTER, MASS.—Four sewers are to be built at a cost of about $2,850.

FLATBUSH, N. Y.—The town authorities object to the plans recommended by the State Board of Health to avoid discharging the sewage into Mill creek. They claim that the work would cost $500,000.

JAMESTOWN, N. Y.—The city council has for sale $450,000 in sewer, water, electric light and fire department bonds.

BOUND BROOK, N. J.—Focht & Herbert, of Bound Brook, write us that they have been engaged to make surveys and plans for a sewerage system.

JERSEY CITY, N. J.—The board of street and water commissioners will receive bids until Nov. 13 for a 15-in. vitrified pipe sewer in Seventh St., 7,000 lin. ft. of piles, 14,000 ft. B. M. spruce stringers, 8,000 ft. B. M. spruce flooring, 36,400 ft. B. M. hemlock sheathing, 30 ft. iron pipe, 250 lbs. spikes, 700 ft. 15-in. vitrified pipe, 2 receiving basins, 350 lbs. bolts. E. A. Dugan, Chn. Com.

ERIE, PA.—If the vote on borrowing $125,000 for the intercepting sewer is favorable, the work will be carried on through the winter.

WILLIAMSPORT, PA.—The contract for the Third St. sewer has been awarded to D. P. Guise, of Williamsport, at $9,488.

GERMANTOWN, PA.—The council has passed an ordinance appropriating $11,000 to complete the two sections of the Wingshocking sewer, and another appropriating $6,000 for a main sewer at Berkley St.

PHILADELPHIA, PA.—The matter of increased drainage facilities in the 34th Ward, reported by Dr. Taylor, Med. Insp., has been referred to the sanitary and house drainage committees.

HARRISBURG, PA.—Ordinances have been passed for the construction of terra-cotta pipe sewers in Regina St. and Angie Ave.

PITTSBURG, PA.—The city controller will receive bids until Nov. 15 for 15, 18 and 20-in. pipe sewers in several streets. E. M. Bigelow, Dir. of Pub. Wks.

BALTIMORE, MD.—A report on the sewers now under construction by day labor has been made by Mr. Rudolph Hering, who stated that the work is being well done, but that it would be done cheaper by contract. The report pointed out the disadvantages of the day work plan due to the custom of making frequent changes in the officers of cities.

NEVADA, MO.—The contract for the main sewer extension has been awarded to George J. Baer, at $6,470.

FORT DODGE, IA.—The city clerk has been authorized to advertise for bids for material and labor in putting in the system of storm sewerage in the east part of the city.

SPRINGFIELD, MO.—It is expected that the sewer committee will recommend the construction of sewers in four more districts during the winter.

TACOMA, WASH.—The West End sewer has been completed at a cost of about $30,000. It is 3 miles long. 380 ft. in tunnel, with 10, 12 and 18-in. pipe for the rest of the distance.

HAYWARDS, CAL.—The contract for a sewer has been let to Daniel McMahon, of Alameda, Cal., at $27,502.

OTTAWA, ONT.—The board of works has directed Robert Surtees, Cy. Engr., to report upon the cost of a main sewer to drain all the undrained portions of the city.

STREETS.

CAMBRIDGE, MASS.—The committee on roads and bridges have recommended an appropriation of $24,954 for widening Wyeth Ave.

NEW YORK, N. Y.—The department of public works will receive bids until Nov. 15 for regulating, grading, curbing and flagging on 123d St.

ALLEGHENY, PA.—The city proposes to experiment with asphalt paving over the present cobblestones, as has been done in New York.

HARRISBURG, PA.—It is proposed to appropriate $5,000 for repairing streets.

NORRISTOWN, PA.—The committee on streets, roads and bridges will receive bids until Nov. 13 for brick and sand for sidewalk paving. William Vaughan, Chn. Com.

TOLEDO, O.—The committee on ways and means will receive bids until Nov. 20 for $114,716 of street improvement bonds.

CINCINNATI, O.—The county commissioners have awarded the $90,000 bonds for extending West Eighth St. to the German National Bank at par and accrued interest, and $14,000 for improving Columbian Ave. to Irwin, Ellis and Baldwin at par.

INDIANAPOLIS, IND.—The board of public works will receive bids until Nov. 13 for grading and gravelling Quince St.

WAUSAU, WIS.—Contracts will be let for cedar block paving on the main streets.

ST. LOUIS, MO.—The board of public improvements will receive bids until Nov. 17 for repairing asphalt pavements. The bids to be per square of 100 sup. ft. of the cushion and surface coat, 2½ ins. deep; and also per square of 100 sup. ft. of 6-in. hydraulic cement concrete. Secy., E. S. Foster.

KANSAS CITY, MO.—The public improvements committee has awarded contracts as follows for vitrified brick paving: Grand Ave., G. J. Baer, $4,053; Thirteenth St., James O'Donnell, $3,026.

OAKLAND, CAL.—The city council has published notice of intention to grade and lay macadam and bituminous rock paving, cement sidewalks, etc., on several strets.

ELECTRIC LIGHT AND POWER.

MIDDLEBORO, MASS.—The town has voted, by 601 to 116, to purchase the gas and electric plant and establish municipal lighting, the price of the plant not to exceed $62,000. It was voted to issue bonds for $75,000, payable in from 1 to 30 years.

NEWTON, MASS.—The aldermen have authorized the mayor to petition the general court for power to operate a municipal electric light plant, and have authorized the street lighting committee to investigate the cost of such plant.

SALEM, O.—The contract for city lighting has been awarded to Thomas Cooper at $70 for each arc light.

CAPE GIRARDEAU, MO.—The city clerk will receive bids until Dec. 1 for furnishing not less than 20 arc lights of 1,200 c. p. for street lighting. Lights to burn all night. Contract for ten years. George E. Chappell, Cy. Clk.

NEW COMPANIES—Carpenter Electric Power & Light Co., East St. Louis, Ill.; $20,000; Hiram A. Carpenter, E. C. Dawes and J. C. Bush.—Hulings Electric Co., East Liverpool, O.; $25,000.

CONTRACT PRICES.

ASPHALT BLOCKS.—Washington, D. C.—The only bid received Oct. 30 by the district commissioners was from the Washington Asphalt Tile & Brick Co., at $64.50 per 1,000.

MACADAMIZING.—New Brunswick, N. J.—The board of freeholders has awarded the contract for 2¼ miles of 9-in. macadamized roads near Matawan, to Mr. Wilson, of Plainfield, N. J., at $1.65 per lin. ft.

SEWERS.—Brooklyn, N. Y.—The department of city works has received the following bids for sewers in Prospect Place and Rochester Ave.: James F. Gillen, 12, 15 and 18-in. cement pipe, $1.25, $1.40 and $1.75 per ft.; manholes, $35; street basins, $125. Harris & Maguire, $1, $1.40 and $1.65 for pipe, $35 for manholes, $100 per street basin.

FIRE HOSE.—Minneapolis, Minn.—The bids for 3,000 ft. of hose were as follows: W. S. Mott Co., 87 cts. per ft.; Revere Rubber Co., 87½ cts.; Chicago Fire Hose Co., 90 cts.; Columbia Rubber Works Co., 95 cts.; Gutta Percha & India Rubber Mfg. Co., $1.

PIPE.—Sacramento, Cal.—Crane & Co. have been awarded the contract for supplying the city with 2,000 ft. of iron pipe for water purposes, the firm's bid being $28.50 per ton for 30-lb. pipe, or $855 for the entire amount.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

PIERS.—New York, N. Y.—The department of docks will build additional piers on the North River, and probably on the East River also.

SIDEWALKS.—East Orange, N. J.—The contract for laying artificial stone sidewalks on Carnegie Ave. has been awarded to the New York Roofing Co., at 22 cts. per sq. ft.

STONE.—Cleveland, O.—The board of park commissioners will receive bids until Nov. 15 for 750 tons of large and 250 tons of small breakwater stone. Secy., F. C. Bangs.

TOWN HALL.—Winton Place, O.—Bids will be received until Dec. 5 for the erection of a new town hall. Vil. Clk., R. B. Poage, care of Samuel Hannaford & Son, architects, Cincinnati, O.

CALIFORNIA.—The executive committee of the County Roads Association met at Sacramento recently to discuss the proposition for the county to issue $250,000 in bonds for macadamizing the roads.

CANAL.—Schenectady, N. Y.—Proposals for strengthening and protecting the berme bank of the Erie Canal near Schenectady by building 4,150 lin. ft. of vertical wall in cement will be received until Nov. 15. E. Hannan, Supt. Pub. Wks., Albany, N. Y.

CITY HALL.—Jersey City, N. J.—The board of finance will attempt to float $550,000 of 5% gold bonds for the erection of a new city hall.

COURT HOUSE.—San Bernardino, Cal.—The board of supervisors will receive bids until Dec. 20 for erecting an addition to the court house. Clk., T. J. Bolton.

RAILWAY STATIONS.—Oakland, Cal.—The city engineer has been directed to prepare plans and specifications for a $500 freight shed 33 × 60 ft. and a $2,000 passenger station and ferry house.

INDUSTRIAL NOTES.

THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., are building seven consolidation freight and three eight-wheel passenger engines for the Philadelphia, Reading & New England. All are Vauclain four-cylinder compounds. The freight engines have cylinders 13½ × 24 and 23 × 24 ins., driving wheels 50 ins. in diameter, and weigh 128,000 lbs. The passenger engines have cylinders 12 × 24 and 20 × 24 ins., driving wheels 5 ft. 8 ins. diameter, and weigh 96,000 lbs.

THE LINK BELT MACHINERY CO., of Chicago, has recently furnished rope power transmission plants for the new barrel-house of the Standard Oil Co., at Whiting, Ind., the factory of the Lawson Varnish Co., at Chicago, and the factories of the Mississippi Cotton Oil Co., Columbus, Miss., George L. Thompson Mfg. Co., of Chicago, and G. Brulay, of Brownsville, Tex. The advantages of rope transmission are well illustrated by a letter recently received by the firm from the Racine Basket Co., of Racine, Wis., which says:

"The rope transmission obtained of you for our gang saw we have in operation, and must say it is one of the nicest appliances of the kind we have ever seen running. It is almost noiseless, and it does double the work we have been able to do with a belt put in its place."

THE CONSOLIDATED CAR HEATING CO., of Albany, N. Y., has sold its British patents on steam and hot-water car heating appliances to an English syndicate.

THE BERTRAM ENGINE WORKS CO., of Toronto, Ont., announces that it will carry on the business of the Doty Engine Works Co., for the manufacture of steam and gas engines, boilers, yachts, mining machinery, etc. Among its specialties are the Roberts and Mosher water tube boilers. Gen. Man., A. Angstrom, formerly Chf. Engr. of the Cleveland Shipbuilding Co.

THE WILSON & BAILLIE MFG. CO., of Brooklyn, N. Y., has completed 15,000 sq. yds. of concrete for column foundations on five miles of the Brooklyn Elevated R. R. O. F. Nichols, Chf. Engr. The stair platforms of all the stations were also laid by the company. Another large contract just completed is 100,000 sq. ft. of flooring and sidewalk for the Eagle Storage Warehouse Co. The work done by this company is good evidence of the merits of high-grade concrete.

BOSTON RAILWAY EQUIPMENT CO.—The Chicago office has recently been put in charge of Mr. Willis O. Squire, formerly of the editorial department of the "Railway Age." The company's specialties are: Boston gas light for cars, zinc case fusee, brake beam, wheel bearing journal, Merrill's car window ventilator, nut locks, foot guard, etc. The office is in the Phenix Building.

THE MANHATTAN GENERAL CONSTRUCTION CO. has been incorporated under the laws of New Jersey for general construction work, making a specialty of electric lighting, electric railways, etc. Pres., F. H. Prentiss; Vice-Pres. and Gen. Man., S. Marsh Young; Treas., H. M. Steele; Secy., R. W. Hildreth. The offices will be at 2 Wall St., New York; Monadnock Block, Chicago, and Equitable Bldg., Baltimore.

NOTICE TO CONTRACTORS.

SONORA & SINALOA IRRIGATION CO.
58 William Street,
New York, November 5th, 1893.

Proposals will be received at this office until 12 m., December 20th, next, for the graduation of twenty miles, more or less, of the Yaqui Canal on the South side of the Yaqui River, in Sonora, Mexico.

Form of contract and specifications and full information concerning the nature of the work can be obtained at this office. Due notice will be given to bidders of time and place of opening proposals and awarding contract.

E. S. NETTLETON,
45-4t Chief Engineer.